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THE GROWTH AND FUNCTION OF THE MODERN LABORATORY.*

IT is opportune, upon an occasion such as this, when we are assembled at the dedication of the newest of scientific laboratories, to consider for a moment the process of development by which they arrived at the state of efficiency of which this building is so striking an example. Then, too, it is of vital interest to those of us whose work lies in laboratories, and of much more than passing interest to every individual in the community, to have a clear idea as to what good purpose this and other similar institutions may be expected to serve, and how best they may accomplish that purpose.

The marvelous advances of the past seventy-five years are well enough known to us all, and never fail to fill us with astonishment when we stop to think about them. Discoveries and applications of discoveries have followed each other with such rapidity that our sense of appreciation is in a measure blunted, and we fail to realize adequately what they mean to each one of us, in comfort and convenience. No sooner did we become accustomed to the fact that we could telegraph across the ocean, than we were occupied in wondering at our ability to telephone to any one within a radius of several miles, and the great present extension of this radius, and the high probability that we shall be able to talk across the Atlantic in a very few years, does not meet appreciation to correspond

* An address read at the dedication exercises of Palmer Hall, Colorado College, February 22, 1904.

to the difficulties which have been overcome. Gas lighting was not universally introduced before electric lighting reached such a high degree of development that many belated country towns skipped a cog and put in dynamos. If this possibility had been suggested fifteen or twenty years ago, it would have been greeted with incredulous smiles. Only an insignificant minority of us had actually looked through a fluoroscope and seen the bones of our own hands by means of Roentgen's rays, when Becquerel rays and all the various rays from radium intervened to confuse us with the very multitude of wonders. All these great advances have been made possible and have had their origin in laboratories and laboratory methods, so that it is but natural that laboratories themselves should have undergone equally rapid and radical changes.

Eighty years ago there was not, in any country, a single laboratory for the purpose of teaching chemistry. To be sure, the subject had been taught for many years, both abroad and here, by lectures which formed a recognized part of a medical education. At Harvard, Dr. Aaron Dexter was installed as professor of chemistry and materia medica in 1783. In 1791, Major William Erving died, and in his will declared that, "Being unwilling to pass through existence without profiting the community, it is my will and pleasure that a sum of money, not less than one thousand pounds, be paid, as soon as it conveniently can be after my decease, into the hands of the overseers and corporation of Harvard College, for the sole use and purpose of enlarging the salary of the professor of chemistry, who is to receive the annual interest of it." If this quotation adorns my tale, it also points a moral by no means out of date. The Erving professor of chemistry and materia medica, in the year 1811, was drawing the munificent salary of $700 annually.

We get a realistic picture of the facilities for teaching chemistry at that time, from the early history of Columbia, in the first volume of 'Universities and their Sons.' It appears that in 1792 a committee of the trustees of that institution concluded that they needed 'a professor of natural history, chemistry, agriculture and other arts depending thereon.' They further defined his duties in this wise: "The schedule or sketch of this professorship to comprehend the philosophical doctrines of chemistry and natural history under the following heads: (1) geology, or the natural and chemical history of the earth; (2) meteorology, or the natural and chemical history of the atmosphere; (3) hydrology, or the natural and chemical history of waters; (4) mineralogy, or the natural and chemical history of fossil substances; (5) botany, or the natural and chemical history of plants; (6) zoology, or the natural and chemical history of animals."

This program would be sufficient to stagger most of us, and so it is with some relief that we learn a little farther on that the college had facilities for the work, which they described as 'a handsome chemical apparatus * * * and a considerable collection of fossils.' But any growing confidence in the desirability of the position is shattered when we learn that in 1814 the trustees memorialized the legislature, and amongst numerous complaints detailed, the following is not the least grievous. They say, 'they have found it due to the state of science and to public opinion to institute a professorship of chemistry as a part of the academic course, and have appointed a professor without being able to give him any compensation'!

While all teaching was done by means of lectures alone, laboratories did of course exist, though we might well hesitate before

granting them the dignity of that title. They were private affairs, belonging either to rich individuals with a taste for natural philosophy, or to apothecaries, or to some of these lecturers, who provided themselves somehow or other, in spite of obstacles nearly insurmountable, at their own cost, with the means of experimenting. There is a minute description of a laboratory, evidently just such as it should be, in Dr. Ure's 'Dictionary of Chemistry,' the American edition of which appeared in 1821. A few sentences will suffice to give us a picture of the laboratory of that day. Dr. Ure tells us that, 'Many people think that a laboratory level with the ground is most convenient * * * but it is subject to very great inconvenience from moisture.' "In such a place, the inscriptions fall off or are effaced; the bellows rot; the metals rust; the furnaces molder, and everything almost spoils." "In the laboratory a chimney ought to be constructed, so high that a person may easily stand under it, and as extensive as is possible; that is, from one wall to another." "As charcoal only is burnt under this chimney, no soot is collected in it; and, therefore, it need not be so wide as to allow a chimney-sweeper to pass up into it." "Under the chimney, at a convenient height, must be a row of hooks driven into the back and side walls; upon which are to be hung small shovels; iron pans; tongs; straight, crooked and circular pincers; pokers; iron rods, and other utensils for disposing the fuel and managing the crucibles." "To the walls of the laboratory ought to be fastened shelves of different breadths and heights; or these shelves may be suspended by hooks." "The shelves are to contain glass vessels, and the products of operations, and ought to be in as great a number as is possible." "In a laboratory where many experiments are made there can not be too many shelves." The detailed description which he gives as to the necessary equipment, not forgetting even 'a glue pot, with its little brush,' and 'a good steel for striking fire,' is both amusing and interesting, but these quotations are enough to produce a fairly precise picture of a 'modern' chemical laboratory of 1820.

We have another, and much more interesting and historically valuable description of one of these old laboratories, as it was just before the marvelous rush forward began. You will remember that Wöhler, forever famous as the first to break down the apparently impenetrable barrier between inorganic substances and those formed through processes of life and growth, by making urea in the laboratory, went, in 1823, to study and work with the yet more famous Berzelius. He has left us a description of the laboratory, which was in Berzelius's own house. He says the laboratory was 'close to the living rooms and consisted of two ordinary rooms, most simply fitted up; they contained no furnace nor draft, no water nor gas pipes.' "In one of the rooms stood two common pine wood-working tables; Berzelius had his working place at one, I mine, at the other." "On the walls were some cupboards containing reagents, of which there was no excessive variety, for I had to send to Lübeck for some potassium ferrocyanide when I needed it in my experiments." "The arrangement for washing apparatus consisted of a stone water jar, with a stopcock and slop jar beneath it." "The balances and other instruments were in the second room, and near by there was also a little workshop with a turning lathe." "In the kitchen, where the austere old Anna, cook and factotum to the northern master who was then a bachelor, prepared the meals, there stood a little furnace and the sand-bath which was always kept hot." And yet in these surroundings and with these appliances Berzelius discovered sev-

eral elements, isolated others for the first time, determined a great number of atomic (or, as we prefer to call them, combining) weights, worked out numerous new analytical methods, and did much of great importance in organic chemistry. You probably recollect that Sir John Herschel, while at the university in 1819, for lack of a better place, converted his sleeping room into a laboratory, discovered the solvent action of sodium thiosulphate, so important in photographic processes, and had endless trouble with the chambermaid and his landlady because of the mess he made.

The leading scientific men of those days were as well aware of the necessity of laboratory teaching to convey a proper knowledge of the subject as we are ourselves, and repeated efforts were made to induce college and university authorities to recognize this need. But insuperable difficulties were met, and not the least of these was the opposition of those engaged in teaching the classics. These ultra conservatives, to use no harsher term, were not even willing to grant that chemistry ranked as a science, and vigorously resisted attempts to introduce it as a regular study. To Liebig, at Giessen, belongs the credit of making the first successful breach through these prejudices, and establishing the first chemical laboratory ever opened to students in a university. This was soon after 1824, the year in which he began his work at Giessen. This famous laboratory of his was small and had a precarious existence at first. Ten years after its opening Liebig, in a bitter letter to the chancellor of the university who controlled the funds, complained that he had been given nothing but four bare walls, and no money whatever for equipment or running expenses. Every piece of apparatus, and every chemical in it, he had bought and paid for out of his small salary. His patience was exhausted and he threatened to resign, and to make known the treatment he had received in justification of his resignation. In response to this, and stirred by the fear of the scandal that exposure would cause, the chancellor provided the minimum amount of money necessary to appease and retain Liebig. But students had flocked to Giessen from every civilized country, and returned inspired and eager to follow Liebig's example in their own homes. Laboratories, and courses in chemistry, modeled on Liebig's, sprang up in too rapid succession to follow. We may, however, describe one or two of the beginnings in our own country.

Chemistry was taught in the laboratory in the medical department of Harvard, in the city of Boston, at an early date, and in 1846 a new medical school was built, the basement of which was devoted to a chemical laboratory capable of accommodating 138 students. In the academic department recognition of the subject was slower. Professor Josiah P. Cook, Erving professor of chemistry, who died only a few years ago, succeeded in getting a small laboratory fitted up in the basement of the main university building in 1851, and President Eliot was the first student to take advantage of the opportunity offered.

At Yale Professor Benjamin Silliman and his son established a laboratory of analytical chemistry and mineralogy, as a private venture, and it became of sufficient importance to be incorporated as part of the university in 1847. This proved to be the nucleus from which sprang the present Sheffield Scientific School.

The University of Michigan is generally recognized as having always set the pace for other state universities, and maintained its leadership in this department also, by being the first of them to introduce the laboratory method in teaching. Three years after Professor Cooke had begun educating President Eliot, Dr. Douglas, of

the University of Michigan, was instructing a class in qualitative analysis, in a small room of the medical building, now utilized as a preparation room for lectures. A building exclusively for the teaching of chemistry was finished at a cost of $6,000, including the equipment, and was in use in 1856, or a year before Boylston Hall was opened at Harvard. In one of his reports, written as this laboratory was nearing completion, President Tappan says that it 'will unquestionably be unsurpassed by anything of the kind in our country.' Every few years the demands for more space became so urgent and so obvious that an ell was added, or a cellar was excavated, until, in that huge labyrinth, whose very floors are worn through by constant use, as it stands to-day, one may study the development of laboratories, as the geologist studies the development of the earth, by an inspection of the strata. It is worthy of remark that we have the promise of our board of regents that the next large building which they undertake shall be a new chemical laboratory.

Turning now from this review of by-gone times to the present, we may well marvel that such a complete revolution of conditions could occur in fifty years. It would be harder to find a university without moderately good laboratories to-day than it was to find one with them in 1850. And they are increasing in numbers and size, through the munificence of individuals and of legislatures and governments, at a surprising rate. These modern laboratories need no description, for we have the actual model here before us.

At no other period in the history of the world has so much money been available for the teaching and the advancement of science. The great endowments and bequests of recent years, as represented by the Carnegie Institution, Leland Stanford University and the University of Chicago, to mention only three, are as well known to you as to me. I had the curiosity to look through SCIENCE, for the year 1903, and to add together all the sums recorded there as actually given during that year to colleges and universities, excluding items that might be simply newspaper rumors. It was surprising to find that they footed up to $15,241,533. Add to this Carnegie's ten millions to the Scottish universities, and the McKay fortune, variously estimated at from four to twenty millions, which is to go to Harvard eventually, and the total is truly princely.

Such figures lead very naturally to the question: Have the universities deserved such sums, from the point of view of what they have accomplished in the past, and can they possibly require more than they now have? Any one who has had to do with a university can answer in the affirmative to each of these questions without hesitation and without qualification. It is my intention to prove that all the money ever given to the cause of education and science does not equal a fraction of one per cent. of the returns made by them, and at the same time to prove that no better, nor more surely profitable investment for money is to be found, than in increasing these endowments and bequests many fold. In the first place, we should realize that most of these gifts are principal sums, and the interest only is available, which puts a different aspect on the question at once. Furthermore, we must also realize that most of the bequests are for specific purposes, and very generally are so hampered with restrictions that they can not be applied where they will do the most good. An illustration of the way in which such conditions may work out in the course of time is the bequest of a well-meaning clergyman made more than a century ago to Harvard, the interest of which was to support a preacher among the Indians.

He evidently intended to protect home industries, but the bursar's checks have to travel a long way now. It is not in the least essential to my argument to diminish the total amount to be accounted for, rather let it be imagined that all the money now invested in the buildings and equipments of our universities has completely vanished, and still we shall be able to find hundreds of dollars' worth for every dollar expended on laboratories or scientific work.

The duties or functions of laboratories have always been, and properly are, twofold, to teach and to advance knowledge, Some have been devoted exclusively to teaching and others exclusively to research, but the best balanced are undoubtedly those which take up the full burden and do both. The results along either line are ample to justify my contention. Consider what some of the discoveries made in laboratories have been, and what they have meant to civilization. It is not my intention to weary you with a list of several hundred valuable discoveries, but rather to call your attention to certain characteristics possessed by them, not often enough emphasized. First and foremost among these characteristics must stand the fact that, with scarcely an exception, those discoveries which have been of the greatest material benefit to society have been the results of disinterested research in pure science, complete and unconditional gifts to the whole world. Brandt received nothing for his discovery of phosphorus in 1669, but after the lapse of a century and a half it gave us those simple but indispensable conveniences, matches. Valerius Cordus, when he first made ether in 1540, and Guthrie and Liebig, when they discovered chloroform in 1831, got no rewards for those godsends they were giving to suffering humanity. Such examples might be multiplied, and they would all have that characteristic—they have been free gifts to mankind.

To my mind, at least, another class of results is even more important than such as these. I refer to the great and fundamental laws, principles and theories of our sciences. For while the chance of financial reward to the discoverer is practically eliminated, they alone make possible the far-reaching applications of science, and assure us of a continuation of our advance, by furnishing the firm working bases. Who can estimate the value of Dalton's atomic theory, and all the patient and painstaking work involved in the determination of the atomic weights, for the manifold chemical and allied industries, and through them for us all? How much was Faraday's discovery and study of the phenomena of electrical induction worth, bearing in mind that it made possible our dynamos and motors? Scarcely an electrical measurement is made but what Ohm's law is used in the calculation, yet how many of us have stopped to think what an immense saving of time and money is effected daily by that simple formulation of his? But once more there is danger of becoming prolix with such a vista of apt examples opened out before me.

The reproach is sometimes made by those who know little of science, that much of the research work done is useless from the practical point of view, and results only in scientific curiosities. Such curiosities were cerium and thorium at one time, but now we have the Welsbach gas mantle. The scientific curiosity of to-day is very apt to become the household necessity of to-morrow. A friend once watched Faraday in his laboratory for a while, and then asked him of what use such work could be. Faraday immediately replied with the question, 'Of what use is a baby?'

It is not impossible that the objection might be raised that many of the newest

inventions at least are patented, and that then tribute is levied in the shape of royalties. This is true, and it is somewhat unfortunate, also, that in the majority of instances the wrong man gets the royalty. A law of nature is not patentable, but the application is, and so it comes about that the real discoverer, retiring and absorbed in his science as he must be to produce his intellectual marvels, is overlooked by the public, overshadowed by some one who happens to find a patentable application of a discovery in which he took no part. It is worth pondering a moment that practical and patentable are not synonymous terms. It is far from my intention to imply that the patentee does not deserve his royalties; he unquestionably does, and fills an important and necessary function in the social economy.

In any case, such tribute as is levied in this way is but a small fraction of the worth of the invention, and the public always gets a good bargain. The actual value, in dollars and cents, of that portion of the fruits of scientific labor which is given for nothing is hard to estimate, but perhaps we may get a notion of it by analyzing one specific case. Suppose some one unprincipled individual obtained an absolute and unquestioned monopoly of all telephones to-morrow. Suppose him to be under no legal restraint, and that he proceeded to squeeze every user of a telephone as hard as possible. It is safe to predict that single business firms would pay him thousands of dollars, rather than lose that indispensable adjunct to their facilities for carrying on their work. Add together all that he could possibly get in this way from all over the world, and subtract from this total the amount now being paid, and we shall get the value of one little gift of science to mankind. Is it extravagant to estimate this one item, as exceeding the total cost of all educational institutions since the dawn of civilization?

Let me put the question in another form: What is the total value of all the time saved by telegrams and by our present means of transportation? And again, how much would you pay for enough antitoxin to save your child from death by diphtheria? These things are inestimable, and my original statement stands proved.

Professor Dewar drew a particularly illuminating comparison about a year ago. He wished 'to find out exactly what some definite quantity of scientific achievement has cost in hard cash.' He found that 'the total cost of a century of scientific work in the laboratories of the Royal Institution, together with public demonstrations,' was £119,800. This is the price which was paid for all the achievements of Young, Davy, Faraday, Tyndall and Dewar himself. No wonder that Dewar reaches the conclusion 'that the exceptional man is about the cheapest of natural products.' We may sum all this up by saying that it is impossible to fix the value of the results obtained by research workers in laboratories, for the simple reason that they have been the *creators of nearly everything that makes money worth having.*

And so far we have touched upon only one of the two functions of our universities and laboratories. The laboratory of yesterday taught the engineer and the doctor of to-day, and the laboratory of to-day is training the discoverer and inventor of to-morrow. The value of the educational work done is so generally recognized and attested by the donations of private citizens, and the constantly increasing grants made by far-sighted legislative bodies, that it requires no elaboration. It admits of no argument that the total knowledge of the human race is worth more than all the money in the world. Our constant strides to higher and higher planes of enlighten-

ment which were never so rapid as now, and which seem to be subject to a law of acceleration similiar to that of gravitation, are due, we are all of us ready to acknowledge, more than to any other influence, to the constantly increasing numbers who obtain the advantage of superior, of college and of university educations. Statistics taken from biographical dictionaries for a definite period show that one out of every 250 of those with college training do something worth recording in such a book, while of those without this training the proportion is about one in 10,000.

We are too apt to fix our attention exclusively upon the exceptions, upon those brilliant individuals who make their marks in the world, and to withhold deserved appreciation from that much larger number of what we may call the average, the mediocre. Yet these latter do the most of the world's work, and in the aggregate their output is in excess of that of the exceptional individuals. Upon their ability to appreciate and to utilize the discoveries and the methods, found and described by the leaders, depends our advance as a race. The most useful and effective of machines is practically useless and ineffective, if only one man in the world has the knowledge and ability to run it. In this scientific and mechanical age of ours, where specialization has been carried so far in every branch of industry and every occupation in life, there is an ever-increasing necessity for more and better preliminary training, before a man is competent to control and govern the more and more complicated conditions. Upon our laboratories devolves the task of disseminating a general knowledge, broad enough and widely enough distributed, to ensure the recognition and immediate utilization of the great improvements made possible by scientific methods, and also of turning out ever larger numbers of men, thoroughly equipped to cope with the industrial processes as they stand to-day, and with the intelligence to adopt improvements as they appear.

Our manufacturers are rapidly waking to the fact that it is sound business sense, and brings big returns, to fit up private laboratories of their own and employ well-trained scientists to study and to improve their processes. It is strange that, leaders as we are in so many particulars, we should be so far behind the Germans in this respect. They learned this lesson years ago, and to it owe their leadership of the world in nearly all branches of chemistry. A forcible comparison between German and British chemical industries is drawn by Professor Dewar in his address to which I have already had occasion to refer. You are doubtless familiar with it, but a few sample statistics will certainly bear repetition. From details regarding 633 German and 500 British works-chemists, he finds that 69 per cent. of the Germans hold the degree of doctor of philosophy, and 84 per cent. have received thorough systematic training, while 31 per cent. is the outside figure for the thoroughly trained among the British works-chemists. He next finds that the German chemical industries do a business of over $250,000,000 yearly, and that they are largely based on English discoveries which were not appreciated nor developed, in spite of the abundance and cheapness of raw material close at hand. We sometimes forget, in the multiplicity of his accomplishments, that Faraday discovered benzene. He gives figures to show the progress of one of the German firms, that of Friedrich Bayer & Co., which employed one hundred and nineteen workmen in 1875. He says: "The number has more than doubled itself every five years, and in May, 1902, the firm employed five thousand workmen, one hundred and sixty chemists, two hundred and sixty engineers and

mechanics, and six hundred and eighty clerks.'' ''For many years past it has regularly paid eighteen per cent. on the ordinary shares, which in 1902 rose to 20 per cent.; and in addition, in common with other and even larger concerns in the same industry, has paid out of profits for immense extensions usually charged to capital account.'' ''There is one of these factories, the works and plant of which stand in the books at $7,500,000, while the money actually sunk in them approaches $25,000,000.'' Such statistics are producing their inevitable effect, and the demand from our industries for graduates capable, not merely of carrying out qualitative and quantitative analyses, but with a training fitting them to study and improve processes, and develop new ones to meet new wants, is already much in excess of the supply, and will grow larger and more imperative. Only a short time ago a recent graduate was offered a position in our university at $1,500, whereupon his employer raised his salary to $3,000, and wrote to the university jocularly suggesting that it increase its bid to that amount, and he would raise it again.

To meet these demands, as well as the just expectation of society, that laboratories and scientific workers shall continue their free gifts to all, means that our laboratories must not merely keep abreast of the times, they must keep ahead of them. To do this they must have apparatus and equipments which grow more elaborate and more costly each year.

Thinking of the astonishing results obtained by the pioneers of chemistry and of physics, as compared with the extreme simplicity and the paucity of their instruments, it is natural that the first impulse should be to conclude that our modern laboratories are extravagant in their demands. But there is more sound truth than there is generally conceded to be in that time-honored jest about the young aspirant for scientific laurels who, after a long search through the archives of science, came back to his professor with the bitter complaint that 'all the easy things had been discovered already.' The domain of science is not exempt from the general law that the simplest and easiest is done first, and saying this should not be construed as detracting in the least from the fame of a Columbus of science who launched forth in the courage of his convictions, and after much hardship discovered a new world. The first comer had but to pick the plant nearest at hand to obtain a new specimen, and the roughest sketch of the coast line was a great contribution to knowledge. But think of the years of skilled labor, the reams of calculations, and the thousands of exquisitely made instruments that had to be employed before the government could issue those perfect charts of the waters surrounding our country. It was not so very many years ago that gold and silver could be found on and near the surface hereabouts, but that is not now the case. It is said, and it is no doubt true, that the treasures of the Rocky Mountains have been no more than scratched as yet. These scratches are on the surface, and the easiest ones to make, and you must dig more mines and deeper each year. Once a pan and a stream of water were the essentials to wash out a fortune; now gold-bearing quartz is crushed in the stamp mills, and is treated by the cyanide process. Your modern gold mine requires an initial expenditure of one or two hundred thousand dollars before it begins to pay dividends. The analogy is perfect. The prospector's pan of yesterday is to the installation of to-day as the laboratory needs of yesterday are to the laboratory needs of to-day.

Please notice it pays well to dig deeper, to crush the ore, to concentrate it and to send it to a smelter. The processes are

longer and more expensive, but the investment is still returned with high interest. The problems to be met have been growing more difficult, but they have been met, and successfully solved, by those with laboratory training, or by those who have profited by the knowledge of the facts dug out in the laboratory. More problems, and more difficult ones, will arise, and they in their turn will be solved, if laboratories and their equipments are maintained at their highest degree of efficiency by liberal endowments and grants. But it would be as absurd to expect our men of science to cope with the complex questions of the present and the immediate future with antiquated utensils, as it would be to send our sailors off in the wooden ships of the war of 1812 to grapple with the Japanese navy.

The idea that a given sum will build and equip a laboratory, and that once set going it will run itself and require nothing more than occasional small sums to replace loss by breakage and the like is a pernicious fallacy. New methods, requiring new or improved instruments, appear each year, and these instruments must be had, if there is to be any pushing forward into the unknown in the branch to which they are adapted. It is a noteworthy fact that, crude as the materials of the early experimenters were, they were the best for their purpose to be had in the world of that time. Faraday insulated his wires with bits of string and old calico, but no one had better insulated wire. Davy obtained sodium and potassium by electrolysis, but he had the biggest and best galvanic battery in existence at the time. It would have been practically impossible to discover Hertzian waves, or Röntgen rays, or wireless telegraphy, without the best of induction coils. And so we might continue *ad infinitum*. It is clearly impossible for one laboratory to have the best of everything, but it is equally clear that each laboratory should have a fairly representative equipment on all general lines, primarily for teaching purposes, and should have an outfit equal to the very best for one or two topics. These topics should be different in different places, and may often be adapted to special localities; they should be chosen by the members of the instructing staff according to their individual aptitudes and interests.

Our laboratories have overwhelmingly justified their cost by their past history, and are justified in making greater demands than ever, by the importance of the functions which they fulfil.

It is to be hoped that philanthropists will be still more liberal than they have been, and that the people will tax themselves more than they ever have, through their legislatures, to give to all schools, colleges and universities. Such money is the fire insurance and the life insurance of society as a whole, guaranteeing the maintenance of law and order, and the ability of the next generation to support the burden of advancing civilization, when its turn comes.

S. Lawrence Bigelow.
University of Michigan.

*IS THE COURSE FOR COLLEGE ENTRANCE REQUIREMENTS BEST FOR THOSE WHO GO NO FURTHER?**

The question is an old one. Is there conflict or harmony of interests between secondary and higher education? Should the high-school student be laying foundations for future study, or should he be doing work that is complete in itself, so far as it goes; or may he not secure a maximum of present utility while laying satisfactory foundations for future studies? I should prefer to discuss the question the other

* Address delivered before the Biological Section of the Central Association of Science and Mathematics Teachers in Chicago. General subject of the meeting: 'Essentials of a High-school Course in Biology.'

end about, for the need of the majority is the constant term involved—fairly constant, at least, since that need will change only with the slow alteration of environment—while the entrance requirement is a much more variable quantity. Let us ask then: Is not the course in biology that is best for the student who ends his studies with the high school a good and satisfactory preparation for college?

When the struggle for existence between subjects now contending for place in the school program shall have worked itself out we shall probably know better what is best for the majority 'who go no further.' Now we must needs exercise foresight, while hindsight will be much clearer. We may gain some hints of things to come by comparing the situation with respect to these newer subjects with the state of those that have reached the end of the struggle and established themselves. The subjects now universally conceded a place in the school program, such as reading, writing, arithmetic, spelling, grammar, geography, etc., stand in marked contrast with some of the newer subjects as respects articulation. These older subjects are orderly, consecutive and complete in themselves: the student drops any of them anywhere without loss—with only gain for what he has had—even though, for example, he stop between short and long division. The list of such studies is longer than it once was; and it may well be that other subjects will come to take their places as essentials when they demonstrate the same degree of educational efficiency and adjust themselves in orderly and progressive sequence.

It must be admitted at once that at present there is no biological program. Studies of living things begin in some places in the kindergarten; in some, in the grades; in some, in the high school; in some, in the college; and in some they do not begin at all. In some they are continuous; in some, interrupted; in most there is little effort at articulation. The unsettled state of our subject is remarkably evidenced in three different ways: (1) The rapid shifts of emphasis as to what shall be taught, (2) the diversity of high school text-books and (3) the indefiniteness of the college entrance requirements.

1. The shifts of emphasis are due chiefly to the fact that most of our nature study has been handed down from above, instead of growing up from below. High-school and normal-school zoology and botany have too often been handed down ready-made by university professors. In my own high school days it was all systems of classification they were handing down. In my college days, it was all anatomy; now it is nearly all ecology. It is now hardly more than a decade since many teachers, newly returned from college or normal school, where their zoological training had consisted in dissecting a cat, were trying the same course they had taken, without dilution or alteration, on the little innocent children. This did not last long, however, for the body politic is more or less resistant to the germs of educational diseases; but it lasted long enough to leave in the mind of the public an unsavory impression of zoology, not yet entirely lived down.

2. The diversity of text-books is very great, in both subject matter and method. Some of the recent ones are all reading—storiettes about animals and plants; some are all dissecting; some are all keys and descriptions for determining of forms; some are all physiology; some are all experimentation; some are all ecology, and some are admixtures of some or all of these things. This diversity is the result of trying to fit one of the most extensive subjects with which the human mind has to deal into one of the smallest niches in the high-school program. Each author appears to have included what he has been able to get

in satisfactorily, and to have lopped off the remainder. And if any one wishes to learn whether these different things are considered pedagogical equivalents, just let him read the prefaces of these books!

3. The usual college entrance requirement in biology at present is 'one year of *some laboratory science*'! Surely this is broad enough to meet the demands of pioneer conditions.

What we have settled among ourselves appears to be that it is worth while to study living things at first hand. Since we may not do more, let us congratulate ourselves that we have progressed thus far, and pull ourselves together for a new start.

What of biology shall be taught in the high school? Is not this a pedagogic question? Yes, as are all questions of fitting subject matter to the receptivity of the developing mind. Is it not also a scientific question? Yes, as science must adjudge the worth of the subject matter. But biological education is more than either pedagogy or science—more than details of instruction, or biological phenomena. It must be in the long run orderly and progressive development toward fitness for the activities of life. The place and portion of biology in the curriculum will not be determined by the dictum of the colleges, or the preferences of the schools, or the methodology of philosophers, but by the operation of natural laws chiefly, the law of natural selection. If biological teaching survive in the high school or anywhere else, it will survive by reason of its fitness as a part in the preparation for life. Therefore, we must never lose sight of the peculiarly intimate relations biology bears to human life. On the practical side, what other subject can compare with one whose chief practical applications are:

First, *living in this world*—hygiene, in its very broadest application, including all personal control over the welfare of body and mind.

Second, *getting the materials of livelihood*—agriculture in its very broadest application, including all that relates to our dependence on the organic life of the world.

Third, *medicine*—the healing art, sometimes mistakenly called the principal application of biology.

I will not mention the multitude of newer applications arising on every hand and making ever-increasing demands for knowledge of the facts and principles of life.

Out of these relations there grow, I think, four incontestable reasons why every one should study biology:

1. To know animals and plants better. We have to deal with them in life. We should know how to protect our friends and combat our enemies among them, and to appreciate the place in the world of all of them. The ancient poetic vision of creation ends with the statement concerning every living thing, 'To you it shall be for meat.'

2. To know our environment better, not alone its economic, but also its esthetic side: to know the charm of life, its wonderful beauty of color and form, its grace of motion, its adaptation to place and function. Here poets and naturalists and artists alike have found themes since the beginning of civilization.

3. To know ourselves better—possessors of animal bodies, that are subject to the same laws, that are moved by the same instincts and that feel the same necessities as other animal bodies, and on the normal healthful activity of which all our possibilities of happiness and usefulness in life depend.

4. To know something of the development of life in the world, and thus to get acquainted with those general develop-

mental principles which underlie modern methods of study in all departments of knowledge: which were first fully developed and are still best exemplified in the field of biology.

Now it seems to me that the consideration of these matters will help us to determine what are some of the things that should constitute part of the intellectual stock-in-trade of the average coming citizen, who will go no further in formal studies than the high school. I will venture to name seven phases of biology now more or less commonly studied, the value of which as parts of a high-school course I consider already demonstrated:

1. Elementary classification—the systematizing of the random observations of nature study in the grades and of contact in life with living things. It need not be very extensive, and might about as well use common names as technical; but it should be a genuine gathering together of known forms into natural groups and a fixing of such groups by names. It will not matter much if, through lack of insight, some forms occasionally get into the wrong group, for such slips still occur with accomplished specialists. Classification naturally and properly follows hard upon the heels of observation, and only goes astray when it runs on ahead. Classification furnishes the handles by which we move all our intellectual luggage. Let us have just enough for our needs.

A modicum of collection making may be allowed here; if fondness is shown for it, it may even be encouraged in individuals and outside the allotted program; and the use of keys analytical should certainly be taught by a little practice. How many naturalists have begun their careers by making collections, and how great and how good is the influence in the present day of the ever-increasing number of manuals and hand-books that are spreading abroad the knowledge of living things.

For many years I have heard professional botanists railing against the old-fashioned course in flower analysis; but I want to testify that I once had such a course, and I have never had a better course in botany or in any other subject whatsoever. It was all nature study of the very best sort and full of the delights of discovery; and the worst that could be said of it is that it was one-sided and incomplete—not a very bad charge, considering the limitations of our knowledge and the immensity of the field.

2. *The study of living nature;* whether we call it old-fashioned natural history or new-fashioned ecology does not matter. In either case we mean the study of plants and animals in relation to their environment. This is the study of the phenomena of fitness. It is simple enough to interest the youngest mind, and profound enough to have furnished the basis for our most important biological generalizations.

It should never be merely reading and talking about remote and wonderfully adapted creatures, but instead, detailed and practical studies of the adaptation of common plants and animals. For instance, protective coloration should not begin with the kallima butterfly, but with the grasshoppers and moths of the dooryard, and results should be secured that are as definite as those of the study of the anatomy of the grasshopper. Merely noting resemblance is not studying it. The pupil should record comparatively the details of the resemblance, whether general or specific, whether in form or in color, how brought about, to what particular environment best fitted, the relative perfection of it, the differences in different animals, etc.

With all the emphasis that is placed on ecology in many recent high-school books,

it is astonishing how little attention is given to pointing a way for the inductive study of ecology on the part of students. It seems hardly to be recognized yet that ecological types are as common and as widely distributed as are morphological types, and that their study may be made to yield equally definite results. It is perhaps excusable, therefore, when teachers read the interesting discussions presented in these books, and instead of applying inductive methods to the study of the same subjects, revert to anatomy for pedagogic results, or else lapse into text-book and recitation methods; but it is still painful, and lamentable, and altogether unnecessary.

There are values of one sort growing out of the intensive laboratory study of a few types; these values have long been recognized. There are other and equal values growing out of the observation of nature in a great variety of forms and relations. These latter values a good ecological program will enable us to realize.

3. A few practical, individual exercises in methods of economic procedure, based on and necessitating a somewhat intimate knowledge of structure, functions and habits of important animals and plants and their enemies—not the mere entertaining observations of nature study in the grades, such as feeding a frog on cut worms: such things should have been done already: but simple practical economic experiments under natural conditions, with the fundamental biologic facts and the desired practical results kept clearly in mind. I would include this, not as a sop to 'practical folk,' though it would in many cases make for solidarity between school and home, but because it is justified on good pedagogic grounds. The youthful mind is practical. Interest is sharpened, and the details of scientific knowledge are better appreciated when things taught are recognized as constituting useful knowledge.

4. The study of reproduction and development. This is in a sense half of biology; for the place of a species on the earth is maintained if it (1) get a living and (2) reproduce its kind. I deem the few local and sporadic attempts that have been made to exclude all consideration for reproduction from the high-school course as an unworthy concession to near-sighted pseudo-pedagogy. For my own part I have always deemed it a privilege to bring to young people some real information as a basis for sane consideration of this much abused subject. Aside from the paramount importance of the subject biologically, I should regret to see this (oftentimes the only) gateway of practical knowledge shut before them. Furthermore, I am inclined to think that the teaching of these matters is needed as an antidote to the smut of the ancient classics and of English history. I judge the results of the teaching of this subject not by the attitude of the student when it is first broached, but by his attitude when the study is done.

Life history studies, it seems to me, are worthy of the greater part of the time spent on these matters, and to these may be added a modicum of embryology of the most elementary sort, preferably, for us in the interior, on the eggs of some amphibian, and a brief, clear and straightforward presentation of the essential features of reproduction, illustrated in the lower forms of animal life and in plants.

5. Physiology, especially the physiology of organs. This already holds a secure and well-merited place; so I but mention it in passing.

6. The study of structure. Anatomy, for a considerable period held the field, almost to the exclusion of every other phase of biological study. But with recognition of the fact that the educational values of biology are far from being confined to the dissecting table, some of the anatomical

work has had to go. We must forever give over the attempt to illustrate the whole gamut of evolutionary changes in a series of types. But we may retain enough of anatomy to be comparative, enough to illustrate kinship clearly, enough to illustrate differentiation, homology, analogy, etc. And may we have this with a maximum of fact and a minimum of terminology! Let us give preference to external anatomy and the study of whole micro-organisms, over internal anatomy and microtome sections. Other things being equal, let us give preference to the sort of work that the interested student may continue after he has left the laboratory behind.

7. Lastly, there should be included the more general conceptions that have grown out of the consideration of biological facts and phenomena and that have taken their places in the world of thought. I mean that there should be considered evolution, with practical studies in the survival of the fittest; the biogenetic law, with practical detailed study of some illustration of the correspondence between ontogeny and phylogeny, etc. These should be introduced because they can not in justice be withheld rather than because the majority go no further. I would have them introduced, also, because some, who are accustomed to get their basis for thinking by more roundabout methods, are still maintaining that biology is a purely observational subject. These all but universal principles the world owes chiefly to biology, and may rightly expect that teachers of biology will faithfully teach them and not withhold the indications of their wide applicability.

Let it be understood that these seven phases of the subject are not offered as a program; far from it. They are not topics for study, but matters to be emphasized in connection with any or all of the special topics to which they relate. I submit that among them is nothing that will not commend itself both for present value and for value as a basis for further progress in biology. I do not believe that any one is well equipped for intelligent participation in modern life if ignorant of these things. Without knowledge of them he will not know how to manage his own garden, his own table, his own appetites, his own emotions or his own thinking. It is, perhaps, true that there are those in circles of culture ready to apologize for the mispronunciation of a Latin phrase, or for the admission of not having read 'Ivanhoe' or even 'Treasure Island,' who would think nothing of it if one should call a whale a fish, or try to kill squashbugs by spraying them with Paris green, or ask what beetles turn into. Indeed, our leading newspapers still publish several times a year the circumstantial details of the case of one who, while drinking at a spring, swallowed tadpoles, and later coughed up frogs. But these things will not always be. On the other side of the matter, I would say for my own part that, so far as knowledge goes, it is some little real and first-hand knowledge of just these seven aspects of biology that I should like to have the high-school graduate equipped with when he presents himself for further work in college. It will have become sufficiently evident, in my opinion, that if the course that is best for life is not best for college entrance, it is so much the worse for the entrance requirement.

Even the few general topics I have named I would not at present *require* to be taught anywhere. I would merely recommend them. For while the science is so new, the field of possible studies so vast and the preparation of teachers so diverse, there is great danger that too much definiteness in a set program may curb initiative and curtail spontaneity. I would let the teachers of the present generation of pioneers do what they can do best to teach the rising generation to see and think, to

know and love their environment and to feel their kinship with the life of the world in body and spirit. Out of this work greater uniformity and better correlation will proceed naturally.

For pioneer conditions must pass. I once had a teacher of arithmetic who had a failing for the duodecimal system; that system had its beauties and its educational utilities also; but it has had to go. As it is no longer permissible to pasture one's cow on the common or to pick strawberries in any fence row, the time is sure to come when it will not be permissible for any teacher to teach what he pleases and when he pleases, according to the exigencies of his situation, the limitations of his knowledge or the prevailing fashion of his university. But it is this very freedom that allows the development of the possibilities of the subject; elimination will come later. May it be natural elimination, and not the forced kind that education suffers when 'men of violence take it by force.'

What is best for life is not completeness, for that is unattainable; not so much great knowledge, as a little knowledge rightly attained with an appetite for more. One danger in programs is that knowledge will be the chief end sought. But another and perhaps even greater danger is that they will be arranged from the standpoint of the specialist without due regard to the standpoint of the learner. How often has it been forgotten already that we had fingers before forceps, eyes before lenses, lenses before microscopes, jack-knives before scalpels, scalpels before microtomes. I have never found a truer statement of this matter than the following one from Professor J. Arthur Thompson: 'A circuitous course of study followed with natural eagerness will lead to better results than the most logical programs, if that take no root in the life of the student.'

I can not help feeling that science teaching, while it has earned its place, has fallen far short of accomplishing that public good for which we may reasonably hope: the diffusion of honesty and directness of method and respect for the simple truth; the abandonment of dogmatism and superstition. Perhaps it is because of the essential conservatism of human nature; perhaps it is because this teaching starts too late and finds scant lodgment in soil already stocked with the notions of an unscientific age; perhaps it is because that teaching is not yet direct and forceful enough to take hold upon the life and to touch the springs of conduct. But ultimate failure in these respects would rest especially upon biology, because of the intimate relations it bears to the life of the people.

James G. Needham.

SCIENTIFIC BOOKS.

REPORTS OF THE BELGIAN ANTARCTIC EXPEDITION.

Résultats du Voyage du S. Y. Belgica, en 1897–8–9, sous le commandement de A. de Gerlache de Gomery. Rapports Scientifiques, publiés aux frais du Gouvernement Belge, sous la direction de la Commission de la Belgica. Anvers, J. E. Buschmann. 1901 (et seq.). 4to, with plates and text-figures.

After the return of the Antarctic expedition on the Belgica, in December, 1899, by royal mandate a commission was appointed under the presidency of General Brialmont to supervise the publication of the scientific results. It is proposed to issue these in ten quarto volumes, the edition to be of 500 copies, exclusive of separate copies of the several papers, which, being issued with individual pagination, dates and covers, may appear as promptly as possible after preparation; the assembling into volumes being a subsequent arrangement.

Quite a number of these papers have already appeared, so that it seems desirable to give our readers some idea of what has been accomplished, although considerations of space will restrict our comment to the utmost limit of brevity on the present occasion. In a gen-

eral way it may be said that the manner in which the several papers are printed and illustrated is most satisfactory. The extremely barren nature of the region in which the party explored, renders many of the papers very short, but the possession of any well-founded results from this inhospitable region is a boon for which we are permanently indebted to the heroism of the explorers and the liberality of the Belgian government.

The date of issue of the several parts, as noted on the second page of each memoir, being often different from that appearing on the cover, we have cited the former in the following synopsis of the parts which have, so far, reached us.

'Astronomie, Etude des chronométres'; I., Méthodes et conclusions. G. LECOINTE (62 pp., 5 pl., 1901). II., Journal (131 pp., 1 pl., 1901).

'Météorologie. Aurores Australes.' H. ARCTOWSKI (64 pp., 2 pl., 1901).

Sixty-one auroras were observed during thirteen months. The maximum frequency was near the equinoxes, the diurnal maximum between ten and eleven P.M. A 26-day period was also plainly marked. The general characteristics were remarkably similar to those of boreal auroras, notwithstanding the great difference of the surroundings. Particularly intense displays were usually coincident with similar displays recorded simultaneously in the arctic observatories, and were observed to coincide with the appearance of sunspots.

'La neige et la givre.' A. DOBROWOLSKI (19 pp., 1903).

This memoir is chiefly devoted to a study of the forms and structure of snowflakes and hailstones.

'Observations des nuages.' A. DOBROWOLSKI (158 pp., 1902).

The observations taken are minute and full, but were much interfered with during the winter months by fog.

Phénoménes optiques de l'Atmosphére.' H. ARCTOWSKI (47 pp., 1902).

A journal of the parhelia, paraselenia, phenomena of refraction, luminous clouds, etc.

'Océanographie. Rapport sur les densités de l'eau de mer.' H. ARCTOWSKI (22 pp., 1 pl., 1901).

'Détermination de la densité de l'eau de mer.' J. THOULET (29 pp., 1 pl., 1901).

A journal and discussion of the observations and a review of methods of observation in general.

'Botany. Lichens.' Ed. A. WAINO (46 pp., 4 pl., 1903).

Fifty-five Antarctic species were collected, of which 38 per cent. are also Arctic or north European, 53 per cent. new or endemic, and only 19 per cent. common to the Magellanic region or South America, a somewhat unexpected conclusion.

'Mousses.' J. CARDOT (48 pp., 14 pl.) and 'Hépatiques.' F. STEPHANI (6 pp., 1901).

Cardot gives a general review of Magellanic bryology which will be most useful for students of mosses. A second section of the memoir is devoted to the Antarctic mosses. Many of these are finely developed, yet all except two were found to be absolutely sterile, and it is probable that fruit is produced in this region only under exceptional conditions. The species are usually associated, apparently for protection. The three endemic liverworts hide among the mosses. Twenty-seven species of mosses were noticed, of which fifteen are new. Nine of the known species are common to the Arctic regions and the new forms are generally closely related to analogous Arctic species. There is very little in common between the Magellanic and Antarctic mosses, the latter much more nearly resemble those of the boreal flora. This relationship is curiously opposed to the conditions which appear in the fauna, which has hardly any trace of bipolarity. There is in the Antarctic only one phanerogam, a grass, *Aira antarctica*, which has been found in widely separated localities.

'Zoologie. Spongiares.' E. TOPSENT (pp. 54, 6 pl., 1901).

Twenty-six species were obtained in Antarctic waters, eight monaxonids and five hexactinellids, are new. There is no indication of bipolarity in the sponge fauna, which extends to the southernmost position attained.

'Actiniares.' O. Carlgren (pp. 7, 1 pl., 1903).

'Madréporaires.' E. von Marenzeller (pp. 8, 1 pl.).

Caryophyllia was obtained in latitude 71° 09′ S., *Desmophyllum* in 71° 18′, and a new species, *Errina gracilis,* in 71° 19′. The '*Edwardsia*' stages of actinians were obtained in the tow net as far south as 71° 15′, and are described and figured.

'Seesterne.' H. Ludwig (pp. 72, 7 pl., 1903).

A detailed account of the starfishes, with much anatomy and full bibliography. Twenty species are described, eleven of which and one genus (*Belgicella*) are new and mostly deep-water forms; they were obtained to latitude 71° 24′ S. There are no bipolar species but eight are found in Magellanic waters.

'Echinides et Ophiures.' R. Koehler (pp. 42, 8 pl., 1901).

There are eight echini and fourteen brittle stars. The Antarctic fauna is a special one, not closely related to Magellanic or Arctic faunas, and has no bipolar species.

'Brachiopodes.' L. Joubin (pp. 13, 2 pl., 1901).

Two new *Rhynchonellæ, R. racovitskæ* and *R. gerlachei,* and *Crania Lecointei* n. sp., were obtained south of latitude 70° S. The fauna, as in the case of the echini, seems distinct from any other, but most of the few specimens obtained were immature or imperfect.

'Copépodes.' W. Giesbrecht (pp. 49, 13 pl., 1902).

Some thirty species, of which about half were new, and one new genus, were obtained. Twenty per cent. of the species are common to the Arctic region, or bipolar. This memoir has involved much labor and is profuse in detail.

'Acariens libres.' E. Trouessart (pp. 19, 2 pl., 1903); three Antarctic species; 'Acariens parasites,' G. Neumann (pp. 6); ('Aragniés et faucheurs,' E. Simon (pp. 7).

These papers are devoted to Magellanic forms, no Antarctic species are cited.

'Myriapodes.' C. Attems (pp. 5, 1 pl., 1902). Three Magellanic species noted. Includes also 'Collemboles.' V. Willem.

Six species treated, of which three are Antarctic, five new genera are proposed. Two of the Antarctic genera have no known close relatives elsewhere, the other, *Isotoma,* is cosmopolite. The Antarctic species have the eyes of reduced size and number, and the author thinks this may be due to the dim light of this cloudy region, and the tendency to adopt for protection a subterranean situs.

'Seals.' G. E. H. Barrett-Hamilton (pp. 20, 1 pl., 1901).

The species of the region were already known to science though imperfectly. The collections of the expedition enable the author to add important osteological and other data on the rare Ross and Weddell seals.

'Cetacea.' E. G. Racovitza (pp. 142, 4 pl., 1902).

The outfit of the *Belgica* unfortunately comprised none of the equipment needed for taking large whales, though the region abounds with the humpback, finback and other species. The true right whale (*Balæna*) is not found in the Antarctic, though it has been erroneously reported there. The author made the most of his opportunities, however, and obtained interesting photographs of the whales in different positions in the water, and many notes, in the discussion of which he settles several doubtful questions and throws light on others. He has inspected the literature of the Antarctic for references to cetacea and has tabulated the results.

'Amphineures, Gastropodes et Lamellibranchs,' P. Pelseneer (pp. 85, 9 pl., 1903); 'Cephalopodes,' L. Joubin (pp. 4).

Professor Pelseneer enumerates a few Magellanic species separately, and divides the Antarctic species into littoral, of which there are three species; fundicolar, of which there are twenty-nine, and pelagic, of which there are five. A few of the species were already known, as abyssal shells, but twenty-seven of the fundicolar species are described as new, and one is given a new generic name. Only four of the species belong to genera not found in the north polar or subtemperate regions, though the species are distinct. Of the two abyssal species previously named, one reaches the Azores, and one Prince Edward Island, in the North Atlantic. There are two forms

which are essentially Magellanic, and all three of the littoral species are related to the Magellanic fauna. The examination of the anatomy of the various forms preserved afforded opportunity for morphological notes of interest, especially those bearing on the relations of *Modiolarca, Philobrya,* etc. The cephalopods were represented only by beaks of cuttlefish found in the stomachs of seals and penguins more or less demoralized by digestive fluids and incapable of identification.

These brief indications will show how much this series of memoirs is likely to add to our knowledge of the Antarctic regions, and how much science is indebted to the intrepidity of the explorers and observers on board the *Belgica.*

W. H. DALL.

SCIENTIFIC JOURNALS AND ARTICLES.

WITH the March issue the *Bulletin of the Michigan Ornithological Club* (quarterly) enters upon its fifth volume. The issue opens with the account of 'The Discovery of the Breeding Area of Kirtland's Warbler,' by Norman A. Wood, which is practically a full life history of this race species with an account of its breeding habits. The article is illustrated by a frontispiece showing the male and female beside a nest; a photo of the egg and other views showing the nesting situation and nature of the country (Oscoda County, Mich.). Chas. C. Adams follows with an article on the 'Migration Route of Kirtland's Warbler,' which is illustrated by three maps. Under the head of Michigan Ornithologists is given a full-page plate of A. H. Griffith, director of the Detroit Museum of Art. Professor Walter B. Barrows, of the Michigan Agricultural College, announces 'A Forthcoming Bulletin on Michigan Birds' to be published by the agricultural college, and requests information from students in the state. Space is given to the Michigan Audubon Society which was organized February 27, 1904, as an auxiliary to the Michigan Ornithological Club, for the protection of birds in the state.

SOCIETIES AND ACADEMIES.

EXPERIMENTAL PSYCHOLOGY.

A MEETING of experimental psychologists was held at Cornell University, April 4 and 5. The session of Monday morning was opened by Professor L. Witmer with a paper on the 'Laboratory Investigation of Backward Children.' This was followed by a discussion of various phases of the reaction experiment, in the course of which the following papers were read: Professor C. H. Judd, 'Analysis of Movements made in Simple and Complex Reactions'; Dr. G. M. Whipple, 'The Simple Reaction as a Test of Mental Ability'; Professor C. E. Seashore (read in absence), "The Psychological Term 'Observer.'" Professor Witmer also spoke on 'Shortest Reaction Values,' and upon the 'Difference between Sensory and Muscular Reactions.' At the afternoon session, Professor Judd read a paper on 'Eye Movements studied by Photography, with Special Reference to the Müller-Lyer, Poggendorff and Zöllner Figures'; Mr. H. C. Stevens outlined a 'Study of Attention by the Method of Expression'; and Dr. J. W. Baird spoke upon recent investigations in perimetry.

The session of Tuesday morning was opened by Professor E. C. Sanford, with a report of Dr. Kuhlmann's experiments upon idiots. Mr. C. E. Ferree emphasized the importance of adaptation in fluctuations of the visual attention, and Professor W. B. Pillsbury discussed the 'Influence of Closing Eyes upon Attention Waves.' At the afternoon session Professor Pillsbury read a paper on 'An Apparatus for Investigating Torsion during Eye Movement, with some Results'; Professor Judd spoke upon the 'Imitation of Tones, With and Without Distraction'; Professor Sanford demonstrated a novel form of color mixer, and Mr. G. H. Sabine a 'Speed Regulator for the von Frey Limen Gauge.' The remainder of the afternoon was devoted to a business meeting, and to an inspection of the psychological laboratory. At an evening session, held in the psycho-educational laboratory, Dr. Whipple spoke upon 'Some Difficulties in the Use of the *A*-Test,' and demonstrated an apparatus for determining the relative legibility of the small letters.

The following papers were read by title: Dr. J. W. Baird, 'Convergence and Accommodation in the Perception of Depth'; Miss M. Castro (paper introduced by Professor J. R.

Angell), 'An Outline of an Experiment Investigating the Interrelations of Taste and Smell'; Mr. C. E. Galloway, 'Fluctuations of Attention and Vasomotor Waves'; Professor E. B. Titchener, "The 'Psychophysical Series' as a Training Experiment: Methods, Results and Computation"; and 'Type *vs.* Instruction in Psychophysical Work.'

It was decided that a similar meeting should be held in 1905; and Professor Münsterberg's invitation to the psychological laboratory of Harvard University was gratefully accepted, with the understanding that the meeting should be transferred to Clark University in case of any interference with Professor Münsterberg's plans.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

The 582d meeting was held March 12, 1904.

Dr. A. F. Zahm continued his paper begun at the previous meeting, discussing several specific problems in aerodynamics in the light of the constants he had determined experimentally; he pointed out that some of the forms of flying machines of noted experimenters had an excessive amount of skin friction, and showed some of the conditions of maximum efficiency in such machines.

Mr. G. K. Gilbert spoke on 'The Feasibility of Measuring Tides and Currents at Sea.' This problem appeals to the geologist as well as to the hydrographer. It was suggested that a hollow vessel might be anchored at some distance below the surface of the sea, containing a registering pressure gauge on which the superincumbent column of water acted. Various forms of gauges were discussed as to their range, sensibility and adaptability.

Charles K. Wead,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of the Academy held on March 21, Professor W. L. Eikenberry delivered a lecture on the 'Principles of Ecology and the Development of Plant Societies.' He showed that the science of botany had been greatly advanced by the study of plant-ecology or plant-sociology, *i. e.*, by the study of plants in their external relations to each other, and the adjustment of plants and their organs to their physical surroundings. Formerly taxonomy, or the determining of a plant's position in a scheme of classification, was the aim of all students and teachers. Now the study of botany is pursued on a broader scale, plants being studied as living things, which are not scattered at haphazard over the globe, but are organized into definite communities, determined by the conditions under which certain plants can live. Ecology, since it considers plants and their environments, takes the student directly into the field, instead of confining him to herbarium specimens. Systematic botany, while very essential, should always be made one of the means, and not the final end of botanical study.

By a series of lantern slides Professor Eikenberry showed the transition from a pond society to a swamp-forest. First we have a lily-pond with sedges at the margin of the water. As the lily-pond loses its water, the sedges and swamp-grasses crowd in. This swamp-moor is followed by shrubs, and finally by a swamp-forest, such as tamarack, pine and hemlock. Professor Eikenberry also traced the developments of plant societies adapted to dry air and soil. Various plants, such as lichens, mosses and small crevice plants, are able to live upon bare rocks. As these exposed rocks are weathered away the crevices become larger, and seeds of small plants find lodgment there. As time goes on, the fissures increase in size, more soil is formed, and shrubs and finally trees root there, resulting ultimately in forests.

CLEMSON COLLEGE SCIENCE CLUB.

At the regular monthly meeting held February 26, 1904, Dr. H. Metcalf presented a paper entitled 'A Contribution to Culture Methods.' The speaker gave a description and exhibition of special apparatus for cultural work in plant pathology, as published in the *Journal of Applied Microscopy* for September, 1903. This was preceded by a demonstration of various bacterial and fungus colonies through the projecting microscope. Professor P. T. Brodie gave a paper entitled 'Engineering Features of the Isthmian Canal.' The speaker discussed his subject under the

following topics: (1) Brief history of the Isthmian Canal problem, with special reference to the Nicaragua, Panama and San Blas routes; (2) comparative advantages of the canals at Nicaragua and Panama; (3) general description of plans for Panama Canal, as made by the government commission and now adopted by provisions of treaty with the Republic of Panama, and a comparison of this with the sea-level canal of de Lesseps and other plans by the French companies; (4) a discussion of the engineering difficulties involved at Culebra cut and the Bohio dam; (5) The Bohio Lake and the Gigaganti Spillway for the control of the summit level and the floods of the Chagris River; (6) a comparison of the advantages of a lock canal at Panama with those of a sea-level canal at Mandingo, involving a tunnel through the continental divide. The lecture was illustrated with forty lantern slides, prepared from drawings and photographs.

F. S. SHIVER,
Secretary.

CLEMSON COLLEGE, S. C.,
March, 1904.

DISCUSSION AND CORRESPONDENCE.

THE UNIVERSITY OF CINCINNATI AND ITS PRESIDENCY.

THE history of the University of Cincinnati for the last five years, has, without doubt, a most important bearing upon the principles of university government. This is due to the features of its early organization and to the peculiar relations which it sustains to the community. The original endowment of a 'free college for white children' by Charles McMicken in 1858, the incorporation of the University of Cincinnati by act of legislature in 1874, with McMicken College as an integral part of it; the issue of city bonds for construction and the levying of a tax for the partial support of the institution, were the acts that gave a free university to Cincinnati.

A municipal university, distinctly anomalous among American universities, had to be provided with a mechanism of government. This was arranged for by the statute which created a board of directors of nineteen members including the mayor of the city, *ex officio*. Originally twelve of these members were appointed by the superior court and six were selected by the board of education, but in 1892 the law was so amended that the superior court appointed the entire board, thus taking it out of politics. The board had and still has control of the funds and of the faculty of the academic department alone, which for a number of years was the only department of the institution actively organized and in working condition.

In the beginning the board of directors invested the dean of the faculty with executive functions, but in 1877 it elected Rev. Thomas Vickers rector. This arrangement lasted until 1884, when, after a long and sensational 'investigation' the executive office again became vacant. An interregnum ensued until 1885, when General Jacob D. Cox, then, and for some years before and after, dean of the Cincinnati Law School, became president. His incumbency lasted until 1888. These two experiences and the dearth of funds prompted the board of directors to revert to the old policy of having the dean of the academic faculty exercise the executive functions in that department, and to provide, furthermore, that members of the faculty in the order of seniority should serve as dean, each one to serve for a year.

In 1887 the board of directors, prompted by a desire to expand the institution to the proportions of a real university, affiliated certain local professional schools, namely, the Cincinnati Law School, the Medical College of Ohio, the Miami Medical College and the Ohio Dental College. Each of the affiliated institutions was only nominally a department of the university, since each maintained its autonomy, its own governing body and acted under its own charter.

In 1892 the relations with the two medical schools were terminated, but the Medical College of Ohio in 1896 by surrendering its charter to the university became the medical department; still, however, with many rights reserved, viz., the right to nominate all the members of its faculty, the control of its funds and of its internal management.

The new arrangement with the law school was a ten years' contract (also begun in 1896) which recognized the right of the trustees of the Cincinnati College to control all funds of the law school and reserved to the faculty the right to nominate all members of the teaching staff and the complete control of its affairs. Thus the law school remained the department of law of the university only in name, a distinction for which the university agreed to pay and yet pays annually out of public tax money the sum of a thousand dollars as 'rental' for premises owned and occupied by the law school itself. The original articles of affiliation with the dental school were not disturbed and the latter institution, a purely private and proprietary enterprise, secures valuable advertising through university publications.

This brief statement sufficiently indicates the influences that were operative, especially during the decade from 1890 to 1900.

The board of directors, made up of business and professional men, acted as safe conservators of the funds of the institution, new buildings were erected in Burnet Woods, the old buildings were given over to the medical school and the material interests of the institution were carefully supervised. At this point the efficiency of the administrative board ended. With no practical university man as a member it failed, for a long time at least, to grasp the real necessities of the academic department.

Each professor conducted his work according to his own ideas of what should be the quality and quantity of devotion to the interests of the institution, with the inevitable *reductio ad absurdum*. Each successor, with the allurements of the vacant presidency before him, sought to make a record that would secure his promotion thereto, while certain of his colleagues, awaiting their turns, were far from giving him a helping hand. 'Members of the board of directors,' so that body stated in a formal declaration, 'received with annoying frequency denunciatory statements from the professors about every member of the faculty.'

'As a matter of fact,' declared the governing body, 'if all the suggestions of removal urged by members of the faculty against members of the faculty had been acted upon, not a single member of the present teaching body would have been left in position.' With incessant conflict in the faculty and with the students not amenable to discipline, things had manifestly reached a crisis. The directors began to think—and one of the first thoughts that came to them was that in all the years that had passed they had been altogether too perfunctory in the choice of professors. Selections had rarely been properly safeguarded, and too many of them had been made through either the 'push' or the 'pull' of the applicant. A régime, absolutely untenable, had become established, the termination of which by radical changes in the personnel of the faculty became the imperative duty of the directory.

This step having been informally but none the less definitely resolved upon, the selection of a new faculty became imminent. The disastrous experience of the directors with the incumbent faculty caused them to recoil from the responsibility. There was a unanimous determination to call a president, a man of executive ability, familiar with the educational world, who, in the selection of new professors, might save the institution from other pits such as those into which it had fallen. Committees were sent to Princeton, Harvard, Yale, Columbia, University of Pennsylvania, Ann Arbor, Chicago and elsewhere. A committee, of which Hon. Wm. H. Taft, then dean of the law school, now secretary of war, was chairman, after investigating a number of candidates reported favorably on Dr. Howard Ayers, then professor of biology in the University of Missouri. Dr. Ayers, after visiting the institution and having been informed of the internal conditions, after having been told that the directors had resolved upon extensive changes in the faculty and after having been impressed that his special and important task would be to select a new faculty and that only the successful reorganization of the faculty and the affairs of the academic department would warrant his continuance, was duly elected. Recognizing an unusual opportunity to render a great service to the cause of sound education, he accepted the office un-

der these conditions and took up the work in July, 1899, in the executive position. He was fully assured that the successful accomplishment of this task would secure his administration and other grateful recognition at the hands of the board and from the community.

The work of President Ayers progressed without special incident until late in the ensuing winter. About this time, after having become familiar with the general situation, President Ayers, in consultation with members of the governing body, insisted that members of the faculty who (some of them before his coming) had been selected for dismissal ought, in fairness, to be notified quietly of the fact in time to secure employment elsewhere. However, before this thoughtful policy could be made effective, members of the faculty themselves on January 12, 1900, precipitated the issue by arbitrarily demanding of the president the names of all who were to be deposed. Certain professors in no wise involved, by inconsiderate action on this and immediately ensuing occasions, rendered their longer retention impossible.

It thus happened that the final number of changes made was slightly increased beyond what was at first intended. The statement was repeatedly made by the daily press that the entire faculty had been dismissed. The fact is that out of a university teaching corps of about 150 members only 8 were asked to resign.

The fact that this action had to be effected through the executive led to the erroneous supposition that the changes were made under the initiative of President Ayers. It was immediately inferred that he was a centralist in university government, an assumption that prompted representatives of the medical faculty, jealous of their prerogative to nominate their own fellows and of their complete control of the medical department, to array themselves in opposition to him.

The matter was taken up by a few citizens who, instigated by deposed professors, called a small meeting and adopted resolutions of sympathy. This was followed by representations to the board of directors that the deposed professors be given a trial. This demand the board of directors, after reviewing the whole case, including the representations that members of the faculty had made about each other, replied: "If the statements made by professors against professors were true the verdict should be upon that basis; if the statements were untrue the moral perturbation thereby implied makes their authors unfit to be identified with an institution of learning; in either event the faculty falls as a self-condemned body."

This incident marked the close of all formal demonstrations. The professors, with two exceptions, completed their year's labor, their work being taken up the following autumn by men who had been selected by President Ayres and who were confirmed by unanimous vote of the board of directors. The internal administration for the first time in many years became tranquil, the enrollment increased and the student body became enthusiastic supporters of the new régime.

A morning paper, however, for personal reasons, had become inimical and kept up a fusilade of abuse, texts for its various articles being furnished by practically the only opposition that President Ayers encountered in his governing board, that of a single member, a representative of the medical faculty, whose coincident service as a professor and a trustee must be recognized as a violation of all correct principles of university government.

This newspaper antagonism was kept up for nearly two years and culminated only when President Ayers by formal vote of the board of trustees had been vindicated of charges, petty in character, that had been preferred against him by his opponent on the board.

The battle so long and bitterly waged against President Ayers had apparently been abandoned. The community at large recognizing that an efficient and harmonious faculty had been installed, that the attendance had increased, that the standard of scholarship had been advanced, that the student body was earnestly and loyally cooperating with the teaching corps, which latter body was enthusiastically engaged in promoting the welfare of the institution, and knowing that benefactors were manifesting renewed interest in the insti-

tution, accepted the condition as a praiseworthy achievement.

The following excerpts from the other city papers indicate that no countenance was given by the press to the attacks of the one morning sheet.

A weekly paper had the following to say, under date of January 13, 1900, about the reorganization of the university:

> Every thorough Cincinnatian ought to feel satisfied that our big university has at last got a head in Dr. Howard Ayers. If an institution ever needed a complete house cleaning the University of Cincinnati did.
>
> For years it has been a burlesque purely through being without a disciplinarian at the head. Dr. Ayers has taken the proper steps to place it upon its feet rightly, and the trustees have shown common sense in supporting him. * * * A continuation of the old methods in vogue at the university can result in but one way—the death of the institution.

January 20, 1900, a local medical journal made the following editorial statement with reference to the relation of the medical and law departments to the university:

> They are and are not a part of the university, and from their first conjunction have occupied anomalous positions, which in the very nature of things can not be harmonious or lasting in their nature. They are a paradox. In neither the medical nor law faculties does the president or board of directors have any voice in their management. They stand at this time as disembodied spirits, and, being disjoined, there can be little or no harmonized unification of interests, which in the general cause of education in Cincinnati is exceedingly unfortunate.

April 14, 1900, a daily evening paper made the following comments on the appointment of Dr. Ayers to the presidency of the University of Cincinnati:

> The public knows little of the troubles that beset the modern college president's path and the peculiar conditions under which most of them have to work. These conditions were suddenly made clear in Cincinnati by the appointment, after years of executive chaos, of a president to the university.
>
> In the current *Atlantic Monthly* appears an article on the perplexities of a college president which might have been written with the late University of Cincinnati discussion as a text, so thoroughly does it meet the points that were raised:
>
> The new president, continues the writer, finds that he is simply left to make the best of the present situation; to do what he may and can with such men as are already in place; to make his peace with malcontents, to be patient under opposition, to do the work of three men because the other two at least are not ready to cooperate with him, to explain misunderstandings, quietly to contradict misstatements when he is so fortunate as to have the opportunity to do this, to supplement the inefficiency of others, and to furnish enthusiasm enough not only to carry himself over all obstacles and through all difficulties, but to warm blood in the veins of others whose temperature never rose above 32 degrees Fahrenheit. To compel him to undertake this work in this way is not only cruel to him personally, but it is as unnecessary as it is unwise.
>
> The writer in the *Atlantic* points to the fact that the educational executive is invariably handicapped by the precedent which, though it grows weaker, is still all-powerful, the feeling that the college professor is to be set upon a pinnacle above criticism and beyond the reach of complaint. "It takes an act of the trustees to put a man in such a position but it takes the act of God to put him out."

Buildings that, for the most part, had been added during President Ayers's three years of service were publicly dedicated at commencement time in 1903 by ceremonies the most successful in the history of the institution, Hon. James Wilson, secretary of agriculture, and Hon. Francis B. Loomis, first assistant secretary of state, being among the orators.

In the meantime, however, another and altogether different set of influences were at work. In the early part of 1902 the Supreme Court of Ohio, in the case of State *vs.* Jones, rendered a decision which practically destroyed all the then existing legislation relating to the government of municipalities in the state by declaring it to be special legislation and, therefore, unconstitutional. The situation was so critical that Governor Nash called an extra session of the legislature, which, on the twenty-second day of October, 1902, passed the law known as the 'Municipal Code of Ohio.'

This law gave to all municipal corporations the right to appropriate property for university purposes, excluded the tax for university purposes from the maximum levy for general purposes, provided for *pro rata* taxation for university property, for public improvements on university grounds; made the city auditor the supreme accountant of the university funds and finally provided that the control of such universities shall be vested in and exercised by a board consisting of nine electors of said municipal corporation who shall be appointed by the mayor. The board thus constituted was empowered to exercise full control over the university.

The provisions of this law, relating to the appointments of trustees, when brought forward in the legislature, were met by appropriate protest, but the principle of uniformity which it was intended to establish in the government of municipalities, a principle by which authority and responsibility alike were centered in the mayor, prevailed—and the University of Cincinnati went into politics.

Of the board appointed, eight members are republicans, and one is reputed to be a democrat.

Scarcely had the eloquence of Secretary Wilson and Secretary Loomis and the applause over the achievements of President Ayers died into an echo, when a concerted move was made to displace the executive under whose intrepid leadership so much progress had been made.

It was then discovered that some of the alumnal members of the board, former pupils of the deposed professors, whom, in one or two instances, they had formerly served in a professional capacity, had entered into a compact with a minister and a doctor—a representative of and a professor in the medical faculty, also members of the new board, to remove President Ayers. About this time one member announced in the public press that he knew how every member of the board stood upon the question of dismissing President Ayers before they were appointed.

It was openly stated that this compact was a written one and that it was entered into not later than a few days after the appointments were made. An inspired article in one of the city papers declared that President Ayers was about to resign, as a majority of the board was unfavorable to his administration.

Word was sent in a personal way to President Ayers intimating that a change in the administration was desired. President Ayers, however, chose to stand upon the record of his achievements and to place the onus of his displacement, if he had to be displaced, upon the board where it belonged.

When the matter became public there were general and surprised inquiries as to the cause. The answers made vague references to 'arbitrariness' and 'lack of tact,' but more generally consisted in the statement that 'Ayers is not the man for the place.' Dr. Charles A. L. Reed, former president of the American Medical Association, and a member of the former board, answered these objections as follows: "There is, it is true, some talk about a 'lack of tact'—but the tact of President Ayers seems to have given the university the best four years since its foundation by Charles McMicken; there are mutterings about 'arbitrariness'—but the arbitrariness of President Ayers seems to be of the sort that has brought order out of chaos and established government instead of anarchy; and there are whisperings about 'tone'—but the tone of President Ayers seems to be of the stuff that, imparted to professors and students alike, has resulted in hard work in the classroom and fair play on the athletic field and that has infused high ideals into the lives of all who have been brought under his influence."

Mr. E. C. Goshorn, a leading manufacturer and business man, wrote: 'To-day the university occupies a position of which we may all well be proud, and it certainly would be a mistake to ask for the resignation of the man to whom this result is due in part if not wholly.'

Hon. John W. Warrington, a leader of the Cincinnati bar, wrote: "I had supposed that the last commencement day of the university furnished satisfactory evidence to all, not only that good work was being done at the univer-

sity, but that there was harmony among all concerned. I regard the present outbreak as highly injurious to the future of the institution.'

Judge Wm. Worthington, one of the most highly esteemed of citizens and a patron of the institution, wrote concerning President Ayres that: "It is undoubtedly true that the university has prospered highly under his management, and that the teaching force has been strengthened, the morale of the faculty improved and the zeal and interest of the students stimulated since he took charge. What has been done is the more remarkable in view of the animosity aroused by the acts he was called upon to perform when he first took charge, and the constant criticisms, engendered in part by those animosities, to which he has been since subjected. His entire and sincere devotion to the interests of the university can not be denied and have borne good fruit which all may see."

Hon. Wm. H. Taft, then Governor-General of the Philippines, wrote from Manila, saying: "Why, after Dr. Ayers has accomplished that which he was employed to accomplish, and has brought about such an excellent condition of affairs, it should now be thought proper to dismiss him, I can not for the life of me see. * * * It would seem to be a time when those who have the interests of the university at heart should sink their personal likes and dislikes and recognize that the man under whom the university has made such distinct progress should continue at the head of it."

The matter was, therefore, postponed from the summer meetings until November, when, notwithstanding the foregoing and numerous other protests from alumni, students and citizens, all of which went unanswered, a resolution was passed declaring the presidency vacant after June 30, 1904, President Ayers being retained until that time. A few days later President C. W. Dabney of the University of Tennessee was elected to the vacancy.

The following are some of the salient points in the situation:

1. The lack of security of tenure of the executive officer of the University of Cincinnati, owing to the inability of the board of directors to make contract, good for more than one year, or in any other way to secure him against sudden and unwarranted dismissal. It is true a five-year contract signed by the officers of the board of directors has been made with President Dabney, but this document has no value beyond the expression of a moral obligation in written form. When President Ayers came to the University of Cincinnati in 1889 he also asked the board for a written contract, and upon being informed of their inability to make a contract for the payment of money not in the city treasury and upon the strongest assurances given him by the board of directors and by other prominent citizens, he concluded that he would be safe in accepting the offer of the presidency without exacting a binding legal document, which, it was discovered, the board was not in position to execute.

2. The instability of the governing board, which is subject to the fluctuations of municipal politics.

3. That the administrative officer who came to the university under very adverse conditions, and performed a task seldom asked of an executive officer, and who, overcoming very unusual difficulties, carried out a successful and satisfactory reorganization of the university, was dismissed without recognition and with a refusal to consider the existing obligations towards him.

4. The effect upon the educational work of the university since the political powers have assumed the direction of its affairs, thereby carrying it into the maelstrom of municipal politics, is such as to render uncertain and unsatisfactory all attempts to carry out any desirable educational program.

5. The unceasing efforts of religious denominations to control the teaching of the university and to establish in it religious conditions which are not permissible in an institution supported by taxation, but which may now be made effective through political agencies.

The careful student of the establishment, government and development of universities will surely find instruction in the foregoing

facts. There are any number of interesting questions involved in the situation. The right of municipalities to support institutions, especially professional and technical schools, in whole or in part by taxation; the practicability of combining endowments with public revenues in the maintenance of universities; the policy of appointing a governing board by political agencies as contrasted with a self-perpetuating board; the question of large administrative boards as contrasted with small ones; the principle of alumnal representation in governing bodies; the right of constituent faculties to representation in the directory, and the results thereof; the right of faculties to nominate their own associates, and the results thereof; the tenure of professional appointments and the obligations, moral and legal, of universities to their executives; are a few themes suggested by recent events in the University of Cincinnati. X.

NATURAL AND UNNATURAL HISTORY.

TO THE EDITOR OF SCIENCE: Every student of comparative psychology who has at heart the cause of sound education must welcome such criticisms of the writings of Mr. William J. Long as have appeared in recent numbers of SCIENCE.* Not because Mr. Long deserves, on his merits, either criticism as a naturalist or condemnation as a teacher, but solely because of the far-reaching influence for evil which must inevitably attend the wide circulation of his books, and their possible offspring, through the schools. The present writer has not asked for space in your journal in which to review the numerous publications of this facile fabricator of fiction, nor yet to discuss the indisputable facts of animal behavior and intelligence which have suffered such distortion at the hands of Mr. Long—to name only the chief of a whole tribe of popular writers who, by the prostitution of their talents, have brought upon themselves the just censure not only of naturalists, but of all right-minded educators.

Since the sad case of the Rev. William J. Long has already been brought forward in your journal, it would seem only fitting that it should be still further presented in all its preposterousness. Let it be understood from the outset that no personal feeling of any sort whatever prompts or accompanies this letter, which is intended solely to place on record a few reflections suggested by the recent controversy in the popular press and the aforesaid communications to SCIENCE, with a view to enlisting still further, perhaps, the interest of scientific men on behalf of a real educational need, and, indirectly, of warning educators against the adoption of a point of view and a method which threaten to make of 'nature-study' not merely a farce, but an abomination to science and a menace to educational progress. Although the writer can have no personal quarrel with Mr. Long, with whose very name he was unfamiliar until Mr. Burroughs—perhaps unwisely?—brought it into unmerited prominence, the duty does not on this account devolve upon him of examining here the statements of *all* our popular interpreters of nature. Mr. Long, to whom public attention is temporarily directed by reason of certain rather ludicrous circumstances, is taken merely as a type of his species. (Doubtless there are naturalists who would limit this particular species to the type specimen!) Mr. Thompson-Seton has also disseminated vicious notions of animal mentality, but, apart from his inexcusable prefatory insistence upon the essential truthfulness of his narratives, and certain matters of taste which scarcely fall within the scope either of this letter or of your journal, his case may be dismissed as relatively unimportant. Besides, it is whispered that he has *reformed*. If Mr. Long is but one among many offenders, he is *facile princeps*, and Mr. Thompson-Seton should not be named in the same breath. Moreover, one may doubt Mr. Long's capacity for reform. As a romancer he does not stand alone, but as a 'hopeless romancer' he occupies a unique position. This is because of his inordinate gullibility. If it turn out that

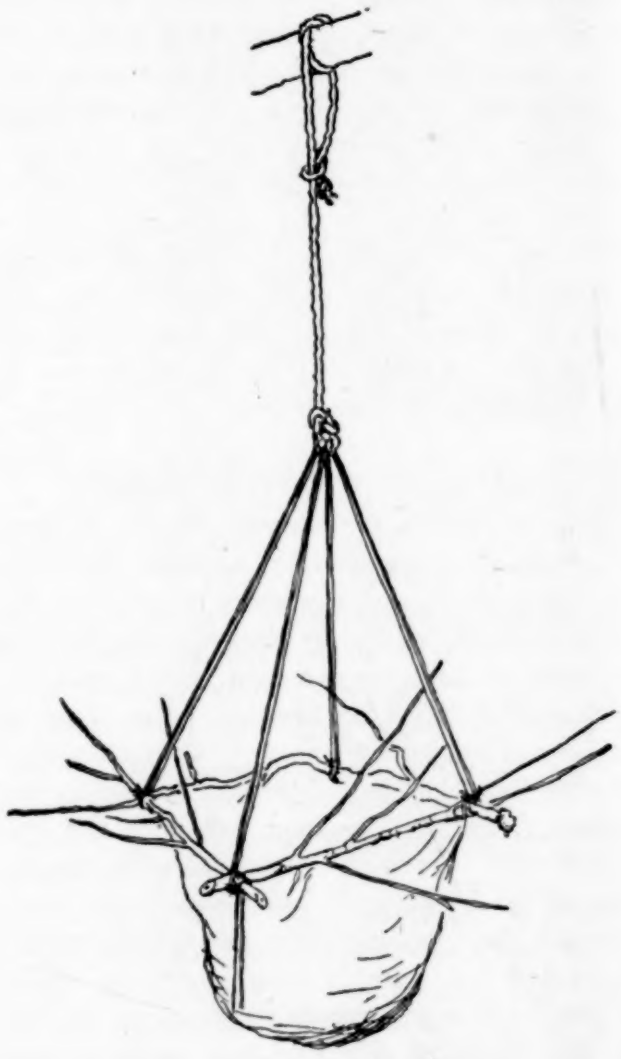
* 'Woodcock Surgery,' by William Morton Wheeler, SCIENCE, N. S., Vol. XIX., No. 478, pp. 347–350, February 26, 1904; 'The Case of William J. Long,' by Frank M. Chapman, SCIENCE, N. S., Vol. XIX., No. 479, pp. 387–389, March 4, 1904.

Mr. Thompson-Seton has really reformed, we shall no longer be permitted to accuse him of gullibility. Meanwhile alternative hypotheses need not concern us here.

That Mr. Long is a 'hopeless romancer' has already been abundantly proved by Mr. Burroughs's article in the *Atlantic Monthly* for March, 1903,* which, although obviously unfair in spots, must be regarded as essentially sound, and in some respects even 'too temperate,' as Mr. Wheeler has said. If anything remained to be added to Mr. Burroughs's effective criticism of Mr. Long's 'sham natural history,' the deficiency has been bountifully supplied by Mr. Wheeler and Mr. Chapman, both eminent as scientific naturalists.†

It would also seem a work of supererogation to attempt further to establish Mr. Long's gullibility, especially after Mr. Chapman's excellent letter, with its telling quotations. Indeed, I have no intention of arguing the matter further, but I happen to have in my possession a carefully prepared outline sketch, executed by Mr. Clifton Johnson, the well-known illustrator, of a mare's nest which Mr. Long has seen fit to describe as the work of orioles, and (by the owner's permission) I beg leave to reproduce it in your journal, that your readers may judge for themselves of Mr. Long's competency to instruct the youth of our land in the 'Secrets of the Woods.' I quote for comparison Mr. Long's own account of this nest and the manner of its fabrication, from his article on 'The Modern School of Nature-Study and its Critics' in the *North American Review* for May, 1903 (pp. 688–698):

Last spring, two orioles built in a buttonwood tree, after having been driven away from their favorite elm by carpenters. They wanted a swinging nest, but the buttonwood's branches were too stiff and straight; so they fastened three sticks together on the ground in the form of a perfectly measured triangle. At each angle they fastened one end of a cord, and carried the other end over and made it fast to the middle of the opposite side. Then they gathered up the loops and fast-



ened them by the middle, all together, to a stout bit of marline; and their staging was all ready. They carried up this staging and swung it two feet below the middle of a thick limb, so that some leaves above sheltered them from sun and rain; and upon this swinging stage they built their nest. The marline was tied once around the limb, and, to make it perfectly sure, the end was brought down and fastened to the supporting cord with a reversed double-hitch, the kind that a man uses in cinching his saddle. Moreover, the birds tied a single knot at the extreme end lest the marline should ravel in the wind. The

* 'Real and Sham Natural History,' *Op. cit.*, pp. 298–309.

† One could have wished that Mr. Wheeler had not felt obliged to indulge in that rhetoric about osteogenesis, etc., presumably intended to take off Mr. Long's manner, but incidentally serving to prejudice certain readers against an otherwise convincing criticism. Surely Mr. Wheeler does not believe that the average country doctor, who sets all the broken bones of his township is 'deeply versed in osteogenesis'! Nor would he deny him, on this account, his proper share of intelligence.—*Non potest non peccari.*

nest hangs above my table now, the reward of a twenty-five years' search; but not one in ten of those who see it and wonder can believe that it is the work of birds, until in the mouths of two or three witnesses who saw the matter every word has been established (p. 692).

Let the description be compared with the sketch; let it be observed that Mr. Long does not affirm that he himself 'saw the matter' (*i. e.*, the fabrication of the nest by the birds?); let it be remembered, however, that Mr. Long accepts this remarkable structure as the work of orioles—there are the usual 'two or three witnesses' (one can not help wondering if they are the same 'friends' who have played so many practical jokes on Mr. Long), and, above all, from Mr. Long's point of view, *there is the nest itself, which hangs above his table now,* unless some ill fate has befallen it since last May, when the article appeared. This episode of the nest reveals a general incapacity for the estimation of evidence which must vitiate everything else that Mr. Long reports. *Falsus in uno, falsus in omnibus.*

The article in question is such a remarkable production throughout that, perhaps, we should not take leave of it without quoting a few characteristic passages, which may serve to set forth Mr. Long's curious creed.

"The study of Nature," we are told, "is a vastly different thing from the study of Science; they are no more alike than Psychology and History. *Above and beyond the world of facts and law, with which alone Science concerns itself, is an immense and almost unknown world of suggestion and freedom and inspiration, in which the individual, whether animal or man, must struggle against fact and law to develop or keep his own individuality.* It is a world of 'appreciation,' to express it in terms of the philosophy of Professor Royce, rather than a world of 'description.'* It is a world that must be interpreted rather than catalogued, for you can not catalogue or classify the individuality for which all things are struggling. * * * This upper world of appreciation and suggestion, of individuality interpreted by individuality, is the world of Nature, the Nature of the poets and prophets and thinkers. Though less exact, it is not less but rather more true and real than Science, *as emotions are more real than facts* [*sic*], *and love is more true than Economics*—* * * 'I study facts and law; they are enough,' says the scientist. 'We know the tyranny of facts and law too well,' answer the nature-students. 'Give us now the liberty and truth of the spirit.' * * * In a word, the difference between Nature and Science [*sic*] is the difference between a man who loves animals, and so understands them, and the man who studies Zoology" (pp. 688–689.—Italics mine here and throughout).

Scarcely could the 'miraculous' vocalizations common among the earlier Christians have been more unintelligible than this. Such crude misapprehension of contemporary philosophic discussions, such hopeless confusion of categories, such aimless emission of words—mere words,—such pitiful cries of an individual struggling against every fact and law, both of thought and of language, 'to develop or keep his own individuality' (which?), it would not be easy to match outside the literature of Christian Science. Specific comments upon our subject's phraseology would spoil the flavor of the original.*

Men of science should perhaps pause to reflect, in the presence of such crass misrepresentations of the nature and scope of science, whether they may not be responsible, in some measure, for the state of affairs which has made it possible for a confessed intellectual anarchist like Mr. Long to obtain a hearing in the schools. If 'nature-study' is what it is above represented to be, let us return without delay to the respectable, if meager, modicum of knowledge comprehended under the one-time useful trinity of R's; but if 'nature-study' has for its object the observation of fact and the recognition of law, without sacrifice of inspiration—if it

* Mr. Long evidently believes in hitching his chariot to a star!

* What a fine case of mixed categories for Professor Münsterberg!—but Professor Münsterberg apparently thinks it unnecessary to dredge in such deep waters of sciolism for his specimens.

be capable of nourishing the normal growing mind—then let us see to it that it be pursued and taught according to the full measure of its possibilities as a legitimate source of inspiration.*

By just such a curious inconsequence as might have been expected from one given to 'speaking with tongues' as above, Mr. Long insists that he has been careful never to record an observation until he has 'verified' it from the testimony of another. The 'confirmation' of most of his stories has come from the guides and trappers of his acquaintance. But in a 'world of suggestion and freedom and inspiration' why bother about verification? Why trouble the trappers? Perhaps the trappers appreciate Mr. Long's 'struggle against fact,' and cheerfully lend their aid in behalf of the development and maintenance of his individuality!

But Mr. Long is not a consistent dreamer of dreams and confirmer of the same through the cross-questioning of trappers; he thinks it important to remind his readers that 'for over twenty years' he has 'gone every season deep into the woods.'* And his publishers, Messrs. Ginn and Company, have issued a little pamphlet,† by way of apologizing for their literary *protégé* and incidentally advertising his books (to all of which Mr. Long submits as if it were quite a dignified thing to be thus personally defended and advertised), in which the public is favored with reproductions *from photographs* of Mr. Long in his boat, of his camp in the woods, and the like. *Mr. Long has been on the ground!* But so have his 'wood folk.' *Mr. Long has been a field observer from his youth!* As much may be said of the wild ass.

Possibly even Mr. Long recognizes that mere camping out among the 'wood folk' is

* No objection is here implied to the frankly imaginative treatment of nature. The same 'fact' may be differently apperceived and transformed by the same mind for different purposes. There is an *artistic* observation as well as a *scientific* observation; accuracy being fundamental to both. Nobody can object, on *scientific* grounds, either to Shelley's relatively objective poems of nature, or even to Wordsworth's humanizing muse. Æsop's 'Fables' and Kipling's 'Jungle Books' are likewise secure from scientific attack. (This of course apart from a possible 'science of criticism.')

There is undeniably a place for *sympathy* in our relations with dumb animals, as in our relations with children; although between the mind of the most 'sagacious' mammal below man and the mind of the child which has outgrown the 'mewling and puking' age, there is probably an interval of considerable psychological significance. Josephine Dodge Daskam's clever stories about children, although not technically psychological, are nevertheless not contrary to fact. Her diminutive heroes and heroines are not made to appear interesting by being fantastically represented as stronger and wiser than their parents, or (like Mr. Long's animals) as differing radically in different localities—the youngsters of Massachusetts, for example, being revolutionary innovators in science and art and conscious critics of government, whereas children elsewhere stupidly make mud pies and dress dolls and harmlessly 'play police.'

But artistic creation apart, the 'natural history' point of view as distinguished from the formulation of quantitative or genetic 'laws,' represents at once a stage in the development of all natural science and a permanent aspect of its pursuit, as exemplified and expressed by nobody so sincerely and so happily withal as by the acknowledged masters of investigation themselves. Furthermore, the perception of 'law' has repeatedly given classic expression to what a scientific student of philosophy, the late Henry Sidgwick, first called 'cosmic emotion.' I am not even prepared to deny the legitimacy of metaphysical construction (possibly a species of quasi-poetry?) upon the basis of an assumed psychic homogeneity of the universe, such as we find reflected in polite literature, as, *e. g.*, in Robert Louis Stevenson's impressive *Pulvis et Umbra* (reprinted in the volume entitled 'Across the Plains,' Scribners, 1900).

* *Op. cit.*, p. 691.

† 'William J. Long and His Books: A Pamphlet Consisting Chiefly of Typical Letters and Reviews in Reply to Mr. Burroughs's Unwarranted Attack on Mr. Long.'—The unfortunate form of this authorized 'defence' of Mr. Long places one under an unpleasant obligation to refer more or less specifically to his personal qualifications,—an obligation from which one could wish to be released.

not in itself a sufficient qualification for the naturalist. Certainly Mr. Long's publishers know better, for they have taken pains, in the published apology already cited, to establish the competency of their author as a naturalist by an enumeration of the successive stages of his education. Quoting from *The Connecticut Magazine*,* they assert that 'his life has been one long search for the verities.' Unfortunately all searches are not rewarded, and length of search is after all of less moment than quality, which depends upon the searcher. Of the last we are told that "at eighteen years he made the sacrifice that few can measure, of giving up home, friends, money, position, to follow what seemed to him the truth," which, being interpreted, turns out to mean that he attended the Bridgewater Normal School, Harvard University, Andover Theological Seminary, Heidelberg University, where he took the degree of Ph.D., and the Universities of Paris and Rome! Are we to interpret this account of his martyrdom as an expression of educational cynicism?† But such self sacrifice is not in itself enough to make a good naturalist. 'He speaks four or five languages.' 'Four *or* five'—but if it should turn out that he speaks only four, and that five are requisite, what then becomes of the argument? No information is given relative to the candidate's preferences in neckwear, not to mention other equally relevant items. 'His specialties,' however, 'are philosophy and history,' and 'the study of nature and animal life is to him purely a recreation in a life of constant hard work,' yet 'it must be admitted that he brings to this study a rare training.' Granted! For it has not even been hinted that Mr. Long has ever studied any branch of natural science. But if philosophy is a specialty with him, perhaps biology is another: for he understands the one about as well—or as ill—as the other. (Witness the confusion of categories exhibited above.)

Let us see if Mr. Long's *methods* are as 'rare' as his training? The pamphlet is again at our service, with its fusillade of quotations from *The Ypsilantian, Our Animal Friends, The Christian Register, The Christian Advocate,* and all the rest! *The Ypsilantian** did not think it 'exactly nice' of Mr. Burroughs to write his *Atlantic Monthly* article; yet, at the risk of offending the good taste of *The Ypsilantian,* let us proceed in the interest of truth. Mr. Richard Burton has assured the readers of *The Boston Transcript*† that Mr. Long 'is a true naturalist, a scientist in quest of knowledge.' (This in spite of Mr. Long's assertion that nature and science differ as emotions differ from facts, and love differs from economics! *Hocus pocus, hocus pocus, X, Y, Z!*) The readers of *The Boston Herald*‡ know better; they know that "Dr. Long * * * never seeks exact facts, never studies consciously." Are we to infer that he dreams his stories? No, rather are we to believe Mr. Long's own account of his attitude toward nature, when he says (if correctly quoted by *The Boston Herald*— we have

* Vol. VIII., No. 1, Series of 1903, Pamphlet, pp. 2, 4.

† It is said that Mr. Burroughs has gone out of his way to emphasize the fact that Mr. Long is a clergyman. If this is true it would seem ungracious. Clergymen are, as a class, probably neither better nor worse than other respectable citizens. While a theological education is fraught with grave intellectual dangers, it certainly need not unfit a man for science, any more than a 'fulfillment of the requirements for the degree of Ph.D.' in a German university need fit a man for the same. There have been excellent naturalists who were clergymen to begin with. Mr. Burroughs's favorite, the good Gilbert White, is a case in point. Others, like the lamented Dr. Buckland, dean of Westminster, have attained eminence in natural science. Bitterness toward the clergy to-day strikes one as an anachronism. The ecclesiastic as we know him is either friendly towards science or indifferent to it, or, in any case, ineffectual against it. Time was of course when things were different; possibly Mr. Burroughs *remembers!* There remain, however, abuses enough to counteract without turning our wrath backwards. The dinosaurs have historical interest for us, although certain of our Mesozoic ancestors may have found it necessary to be veritable 'pragmatists' in their presence.

* July 16, 1903, Pamphlet, pp. 7–8.

† Date not given, Pamphlet, pp. 12–16.

‡ August 9, 1903, Pamphlet, pp. 18–19.

not the 'confirmation' of *The Ypsilantian* on this point): "I just love her, give myself wholly to her influence, expect nothing"—to which one is tempted to add, in the words of a current beatitude, 'Blessed are they that expect nothing, for they shall not be disappointed.' *The Boston Herald* is incidentally careful to explain how Mr. Long became a 'maker of many books.' "Before he was twenty he had filled a dozen note-books with curious, hitherto unrecorded habits of animals." A little later on "he prepared five articles, largely in fun, which, to his surprise, found ready acceptance and yielded a check of astounding proportions. Requests for book material followed, which he has since supplied at the rate of one or two books a year."

*Our Animal Friends** thinks Mr. Long's writings free of 'mawkish sentimentalism,' apparently because he does not insist that the hippopotamus is a 'beauty,' or the skunk a 'desirable companion.' And on July 9, 1903, *Public Opinion*† took the 'opportunity of reaffirming [its] belief in the correctness of Mr. Long's theories and of again advising the study of this author's work.' Just so, Mr. Hamilton Wright Mabie is quoted‡ as remarking that "Mr. Long has a fresh, sincere style, an eager curiosity, *and a trained habit of observation.*" Really, this is worthless from Mr. Mabie; yet just what one would have expected from this 'genial' preacher to the 'Christian Endeavorers of literature,' whose 'tolerance of temper' and 'mellifluous commonplaces' have apparently become too much even for the urbane, yet always discriminating, editor of the *Atlantic Monthly*.§ Nobody takes Mr. Mabie seriously as a critic of values any more. Nor should any man of letters, *as such*, presume to pass judgment on the competency of a naturalist for his task. If Mr. Long adds arrogance to ignorance, Mr. Mabie genially follows in his steps. A wise and far-seeing friend, and a man both able and eminent in science, is wont to predict that the science of the future will have to reckon painfully with a 'humanistic' opposition as dangerous as was the theological opposition of the past and far more insidious. Already there are signs of such an opposition, although as yet it acts chiefly as a stumbling block in the path of popular education; yet, to change the figure, it sometimes stands arrayed in the garb of education itself. *The New England Journal of Education** informs us that, "from Thoreau to Burroughs there has been no man quite so *lovable to wild animals* and to men at the same time as William J. Long. His experiences are well-nigh as fascinating in their way as were the songs of Jenny Lind." Speaking of Mr. Burroughs's criticism, it continues: "No one who has not made a saint of Burroughs and *has not been in love* with William J. Long, can appreciate the nightmare effect of that *Atlantic* article." But let us turn from this erotic effusion, and conclude our notice of Messrs. Ginn and Company's pamphlet by quoting Professor William Lyon Phelps, of the Department of English Literature in Yale University, who is reported as declaring that "*from the point of view of natural history,* as well as that of literary art, these books [by Mr. Long] are masterpieces."† Thus does the humanistic 'mush of concession' ever tend to 'debase the moral currency'; for it levels down as surely as it levels up, until all distinctions are obliterated, and truth remains just where Protagoras would have left it.

I need not discuss Mr. Long's modest-like defense of himself,‡ which would be ludicrous if it were not so pitiful—apart from certain just strictures upon minor faults of Mr. Burroughs's criticism. Which reminds one that Mr. Burroughs does not live in a house without some glass panes. But Mr. Burroughs knows that he has made mistakes, and knows how to account for them too. In the very *Atlantic* article which *The Ypsilantian* did not think was 'exactly nice,' Mr. Burroughs ac-

* August, 1901, Pamphlet, pp. 21–22.

† Pamphlet, p. 24.

‡ Reference not given, Pamphlet, pp. 16–17.

§ 'Mr. Mabie's Latest Book,' by B. P., *Op. cit.*, March, 1903, pp. 418–419.

* June 18, 1903, Pamphlet, pp. 8–11.

† Place not given, Pamphlet, p. 17.

‡ A letter from Mr. Long to the editor of *The Connecticut Magazine*, quoted in Pamphlet, pp. 25–32.

knowledges "the danger that is always lurking near the essay naturalist,—lurking near me as well as Mr. Sharp,—the danger of making too much of what we see and describe,—of putting in too much sentiment, too much literature,—in short, of valuing these things more for the literary effects we can get out of them than for themselves."* This is admirable, and reassures one in venturing upon an illustration of the way in which Mr. Burroughs has himself inadvertently yielded to this besetting temptation of the 'essay naturalist.' For I should be sorry to appear other than an admirer of Mr. Burroughs's writings; and even as a technical student of comparative psychology I agree in the main with his point of view, which I hope to discuss elsewhere, pointing out, for a wider public, what I regard, in the light of recent research, to be the limitations as well as the advantages of his somewhat arbitrary position on the rôle of instinct in animal life. Mr. Long's plea for animal individuality will then receive its full share of attention.†

* *Op. cit.*, p. 299.

† Mr. Long's contention that every boy who has watched animals has something to tell the 'naturalist' is not to be dismissed with a sneer. Some boys certainly have seen many things that no 'naturalist' has recorded. Nobody who has kept live animals feels that the stereotyped account of their behavior is quite adequate to the individual differences and the plastic 'accommodations' which they display; but these very individual differences and 'accommodations,' in so far as they have any importance, are themselves susceptible of *scientific* study. That they have not been sufficiently recognized in certain 'scientific' quarters can not be denied. But, if they have any meaning, they are 'facts' for the 'naturalist,' and as such have in the first place to be established on trustworthy evidence and then interpreted in accordance with 'law.'

The exceptional, even when true, can scarcely be said to furnish the basis for the most wholesome instruction in 'nature-study.' Nor is it of prime importance for science itself. *Cf.* E. L. Thorndike's remarks in his 'Animal Intelligence,' *Psychological Review*, Monograph Supplement No. 8, June, 1898, pp. 3–5. The widespread eagerness in the quest of the unusual and the gusto with which the anomalous is too often greeted when it is found are symptomatic of an intellectual malady which threatens the very life of reason in the community.

This communication is not concerned with questions of interpretation. When it comes to these, the comparative psychologist finds himself in an embarrassing position. His work, if not actually scouted, is often lightly regarded by the neurologist and the pure physiologist, on the one hand, in the supposed interest of a mechanical explanation of nature, while, on the other hand, it is ignored by the ordinary naturalist, untrained in the analytic method of psychology, and poohpoohed by the 'educated public,' complacent in its anthropomorphic sentimentalism. The serious student of animal psychology labors under the disadvantage of having a popular subject to investigate! Wherefore he has constantly to be on his guard and may often seem to be 'carrying a chip on his shoulder' through no fault of his own. If he be not a pessimist, however, he must regard popular interest in his subject as in the long run a boon upon which he may favorably reckon.*

But I have wandered far from my promise to illustrate Mr. Burroughs's tendency to 'slip up' unawares. It is in one of Mr. Burroughs's less satisfactory articles, on 'The Ways of Nature,'† that we read the following description of the peculiar behavior of the common 'sissing or blowing adder' (*Heterodon platyrhinus*), when teased or persistently attacked:

> It seems to be seized with an epileptic or cataleptic fit. It throws itself upon its back, coiled nearly in the form of a figure 8, and begins a series of writhings and twistings and convulsive movements that is astonishing to behold. Its mouth is open and presently full of leaf mould, *its eyes are closed*, its head is thrown back, its white belly up; now it is under the leaves, now

* The camp of human psychologists is not a scientific Utopia, but that were too much to expect in a territory still overrun with such profound personal prejudiees and imagined practical interests,—especially when the invaders are by nature so well-disposed towards the aboriginal enemy.

† *The Century Magazine*, Vol. LXVI., No. 2, pp. 294–302, June, 1903. Citation from p. 299.

out, the body all the while being rapidly drawn through this figure 8, so that the head and tail are constantly changing places, etc.

Surely these interesting phenomena are valued too much 'for the literary effects' to be got out of them; there is an unconscious *heightening* of the description, with the result that the eyes are described as 'closed,' whereas the snakes are characterized, and distinguished from the lizards, by the *absence of eyelids. Nor is there a nictitating membrane present.* Hence their eyes are set in a perpetual stare; although it is conceivable that their appearance might be (slightly) altered by certain movements, yet by no figure of speech could they be properly described as closed.* Mr. Burroughs's writings are of such service as to warrant correction; they are of such merit as to deserve it.†

While it is not my purpose here to sit in judgment *in re* Burroughs *vs.* Long, a characteristic difference between the two men may be noted, in passing, as it is revealed in their respective attitudes toward the great naturalists, Darwin and Wallace. Mr. Burroughs is always deferential, seeking, sometimes inadequately perhaps, to verify their results and to apply their conclusions, while Mr. Long distinctly implies that these observers labored under a serious disadvantage by reason of their limited opportunities for the study of animal life, as compared with his own unusual facilities, 'with Indian hunters' to his aid!*

The controversy between these gentlemen, as has been said, would not of itself warrant the sacrifice of so much space in your journal. "Where there is a manifest disproportion between the powers and forces of two several agents, upon a Maxime of reason, we may promise the Victory to the Superiour," as Sir Thomas Browne quaintly observes in his 'Religio Medici'; but, as he further reminds us, 'unexpected accidents' may 'slip in' and 'unthought of occurrences intervene,' which 'proceed from a power that owes no obedience to those Axioms' [of reason]. And surely in the case under consideration, such 'accidents' (if not 'unthought of occurrences') as popular prejudice, nourished by the indiscriminating leaders of the 'Christian Endeavorers of literature' and fed upon by shrewd publishers, have intervened, 'to make the worse appear the better reason,' and to gain, or momentarily to threaten to gain, the ascendency in the official instruction of youth.

In so far as I have seemed to take Mr. Long's case seriously, it has been only by way of warning, not against the particular extravagances of an individual, but against the unchecked diffusion of the false conceptions and meretricious standards, of which Mr. Long's teaching is typical and his following the unfortunate outcome. It is already too late and must needs be impossible, in our democratic civilization, for men of science to leave 'the public' out of account. If 'a little learning is a dangerous thing' for the individual, it assumes multiple proportions when the bulk of the community becomes infected. This business of popular education is in some respects a grand nuisance! It leads to a thousand blatancies—of bigotry, of cocksureness, of an assumed appearance of superiority without the reality, taking protean forms throughout the entire range of our public activities. Yet, on the whole, 'the greatest good to the greatest number' probably flows from just such an 'equality of opportunity'

* The anatomical fact alluded to might easily have been overlooked, but no knowledge of anatomy would have been necessary to a faithful record of *observed* fact. One of the ablest of our younger zoologists, and a college professor, when his attention was called to this curious statement of Mr. Burroughs, promptly replied in all seriousness, 'Perhaps he refers to the nictitating membrane'! Another zoologist humorously suggested that 'possibly the pineal eye was meant!'—but surely this hypothesis is barred by Mr. Burroughs's use of the plural.

† It is to be regretted, however, that Mr. Burroughs has brought *telepathy* into his animal psychology. See his article 'On Humanizing the Animals,' in *The Century Magazine*, Vol. LXVII., No. 5, pp. 773–780, March, 1904, especially pp. 776–777. One of the consolations of the comparative psychologist has always been his supposed freedom from the 'confidences' of the telepathists!

* See *The North American Review*, article cited, page 695.

as the diffusion of knowledge permits. All must be given a chance to breathe the fresh air, one must suppose, that the born 'saints' be not stifled; while, if 'saints' may be made, there must first be 'Christian Endeavorers' (to continue under the figure already borrowed from the editor of the *Atlantic Monthly*). Wherefore we still need our Mr. Mabies, even as our Mr. Mabies need improvement. We perhaps need even our Mr. Carl Snyders, but we certainly do not need our Mr. William J. Longs. We do need such delightful 'essay naturalists' as Mr. Burroughs; we need also professional naturalists who do not find it necessary to struggle against facts in order to develop or keep their individuality, but who try to make facts themselves attractive to both young and old; we need serious investigators in zoology and comparative psychology, who bring to their task 'an eye well practised in nature,' a mind exacting in its critical demands and furnished with a just knowledge of the results of previous workers, who are at the same time conscious of their obligation, as teachers, to a larger public. Above all, we need to-day, as much as ever, perhaps as never before, men whose attitude toward 'the people' resembles that of a Huxley or a Clifford, a Helmholtz or a Virchow, or that of many a lesser luminary, who by the popular exposition and inculcation of sound *principles* of science, have contributed effectively to the prevalence of light rather than darkness in the world, and, indirectly, at the same time, to the advancement of science itself.

And all these are needed (let it be stated whether *The Ypsilantian* thinks it 'nice' or whether it does not) in order that our children may be spared the painful necessity either of unlearning such pseudo-scientific fictions and anti-scientific prejudices as Mr. Long and his allies represent, or of growing up with minds perverted and ill adapted to survive as rational beings in a world of fact and law, though they struggle never so hard against both in the supposed interest of their individuality.

WM. HARPER DAVIS.

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SPECIAL ARTICLES.

THE ENCYCLOPEDIA AMERICANA ON ICHTHYOLOGY.

'THE Encyclopedia Americana,' now being published, is in some respects a meritorious work, but great carelessness has been manifested in some of the office editorial work. Such is especially the case in one of the articles of the last volume (Vol. VIII.) which has come to hand. The article in question is 'Ichthyology' and its author is President David Starr Jordan. The text is excellent but the illustrations are very badly identified and could not have been submitted to Dr. Jordan. We may imagine the surprise and disgust of the author when he finds the erroneous and strange names applied to more than half of the cuts. Those most erroneously named are the following in regular sequence (the pages are not numbered):

Homocercal tail.—It is the tail of a *Polypterus* and consequently not homocercal at all but diphycercal.

Port Jackson Shark (*Cestraciontes*).—This is not the Port Jackson shark but the bullhead shark of California (*Gyropleurodus francisci*).

Sting-ray (*Raia*).—No species of Raia is a 'sting-ray' and the figure does not represent what is generally called a 'sting-ray,' but a fish of a very different family, the *Aëtobatus narinari*.

Viviparous Perch.—The name is altogether too indefinite and misleading, inasmuch as it is very far from any true perch; it is the embiotocoid *Cymatogaster aggregatus* of California.

Elephant Fish (*Chimæra*).—Not the true elephant fish but the ratfish of California (*Chimæra* or *Hydrolagus Colliei*).

Gafftopsail Cat (*Galeichthys*).—By no means, but the common channel cat of the United States (*Ictalurus punctatus*).

Pike (*Lucius*).—The fish figured is not at all related to the pike and belongs to a different order; it is a barracuda (*Sphyræna barracuda*).

Butterfly-fish (*Holacanthus*).—Not related to *Holacanthus*, but the common *Zanclus cornutus* of the Indo-Pacific region.

Globe-fish (*Tetraodon*).—It is the *Ovoides setosus*.

Rose-fish (*Sebastes*).—The *Sebastodes nigrocinctus* of California.

An Antellarid.—This is by no means an antennariid (as the word meant should have been written) but a ceratiid (*Caulophryne Jordani*).

Bat-fish.—As there are various fishes called bat-fish more definiteness is required than that name alone. The fish figured is the *Malthe vespertilio* of the eastern coast of the United States.

Surely it is a wrong to the public as well as to the author to give such work the wide circulation that the new encyclopedia will doubtless enjoy. The author of the article of course knows—none better—what are the right names to be attached to the figures and those given furnish sufficient evidence of the fact that the proof was not submitted to him—or at least that he did not correct it.

THEO. GILL.

THE MINNESOTA SEASIDE STATION.

THE Minnesota Seaside Station party of 1904 will meet at the Hotel Dominion, Victoria, B. C., about the nineteenth of July. The precise date, depending upon the sailing of the steamer, *Queen City*, will be announced, to those who join the party, when the sailings are determined upon by the navigation company.

The party will proceed to the station and will remain in camp for one month, returning to Victoria in time to reach the east before the opening of the schools in September.

Owing to the impossibility of making agreements about railway rates at the present time, no announcement of a party from Minneapolis can be made thus early. In the past it has been an easy matter to get excursion rates during July so that the railway fare and sleeping car tariff between Minneapolis and Victoria may be estimated under $75. If a sufficient number join the station and desire the organization of a party to make the trip together, such organization will be undertaken and the trip will be made by one of the northern transcontinental routes with the usual stop-offs in the mountains.

The Minnesota Seaside Station is a biological camp and laboratory situated on the Straits of Fuca opposite Cape Flattery and in full view of the Olympic Mountains. The large log living house and the two laboratory buildings are upon the rocky and picturesque shore of the sea, while immediately behind there is the trackless forest of Vancouver Island with scarcely a human habitation. The combination of sea and forest and the absence of any of the distractions of the town make this camp one of the best spots in the country for study, recreation and health, as the hundred teachers and students who have visited it during the last three years can very well attest. During the season sunny weather is to be expected. There is an absence of noxious insects. One may sleep out of doors by driftwood fires and there is a sand beach with good bathing. Leisure moments can be occupied in cod or brook trout fishing, or in hunting.

The laboratories are equipped with microscopes and ordinary laboratory apparatus and during the month one can get a very complete introduction to a knowledge of the plants and animals of the shore. The configuration of the coast is favorable to the development of a varied fauna and flora. There are no restrictions placed upon legitimate collecting, and many of those who have visited the station have brought back large amounts of valuable botanical and zoological material. There are facilities for research and some important work has already been accomplished by members of previous parties.

An interesting feature at the station is lecture work conducted out of doors at various places within easy walking distance of the camp. Evenings are spent with informal talks upon biological or educational subjects or in song and story, sometimes in the large living room of the camp and sometimes around bonfires or mussel-bakes on the beach.

The botanical work during 1904 will be under the general direction of Professor Conway MacMillan, who will conduct special laboratory courses upon the ecology and morphology of the kelps and upon the anatomy and classification of the liverworts and mosses

of the region. Two courses upon algæ will be given by Miss Josephine E. Tilden and a course upon lichens by Dr. Albert Schneider, the author of the leading American text-book upon this subject. Dr. Schneider will also give some lectures upon bacteria and nitrogen assimilation. The name of the instructor in zoology, who will have charge of the zoological laboratory, can not be announced until later. Such courses as are provided are believed to be of the most value to the inland student visiting the seashore.

By special arrangement with the authorities of the University of Minnesota it is possible to accept work done at the seaside station by graduates of colleges as counting for credit towards the degree of master of arts.

The station fee which covers board, lodging, laboratory space, instruction, etc., at the station is $75 for the month. Those who expect to join the party are urged to send in their names as soon as possible in order that the director may know for how many to provide.

Descriptions of the station may be found in *The Popular Science Monthly* for January, 1902; the *Journal of Geography* for June, 1902; and *Nature* for December 18, 1902.

To those who join the party full instructions concerning all matters of detail will be furnished by letter.

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Professor of Botany,
University of Minnesota,
Minneapolis, Minn.

SCIENTIFIC NOTES AND NEWS.

THE Bruce Gold Medal of the Astronomical Society of the Pacific has been awarded to Sir William Huggins for distinguished services to astronomy.

PRINCIPAL C. LLOYD MORGAN, of University College, Bristol, has been offered the honorary degree of LL.D. by the University of Wisconsin, but has been unable to accept the honor because he can not attend the ceremonies connected with the celebration of the fiftieth anniversary on June 9.

CONGRATULATORY addresses will be presented on April 22 to Sir Henry Roscoe, the eminent chemist, on the occasion of the fiftieth anniversary of receiving the doctorate from Heidelberg University. The presentation will be at Manchester, Sir Henry Roscoe having been professor of chemistry at Owen's College from 1857 to 1887.

THE following new members were elected by the American Academy of Arts and Sciences, of Boston, at the meeting of April 13, 1904: *As resident fellows:* Edward S. Sheldon and Herbert W. Smyth, both of Cambridge, Mass. *As associate fellows:* Eugene W. Hilgard, of Berkeley, Cal.; James D. Hague, of New York; Israel C. Russell, of Ann Arbor; Abraham Jacobi, of New York; and T. Mitchell Prudden, of New York. *As foreign honorary members:* Felix Klein, of Göttingen; Adolph Harnack, of Berlin; Pasquale Villari, of Florence; and M. L. Gaston Boissier, of Paris.

CAMBRIDGE UNIVERSITY has resolved to confer the honorary degree of doctor of science on Wilhelm Ostwald, professor of chemistry in the University of Leipzig.

LORD KELVIN has been unanimously elected chancellor of the University of Glasgow in the room of the late Lord Stair.

THE Paris Academy of Sciences has elected the following corresponding members: Professor Volterra in the section of geometry in the place of the late Professor Cremona; Dr. W. C. Brögger, professor of mineralogy and geology in the University of Christiania, in the section of mineralogy, in succession to the late Professor Karl von Zittel, and M. Charles Flahault, professor of botany in the University of Montpellier, in the section of botany, to succeed the late M. Millardet.

M. SANTOS DUMONT has been made a chevalier of the legion d'honeur by the French government for his experiments with dirigible balloons.

DR. CARL DUISBERG, director of the Elberfeld Dyeworks, has been given the title of professor.

IT is announced that Professor A. Graham Bell will give an exhibition of his tetrahedral kites before the National Geographic Society on April 30.

Professor Paul Hanus, who holds the chair of education at Harvard University, will be given leave of absence next year, and will spend the time making a study of foreign systems of school administration. Professor George Santayana, of the department of philosophy, will also spend the year abroad.

Professor Leverett Mears, Ph.D., of the chemistry department of Williams College, has been granted a year's leave of absence and will probably go abroad.

Professor H. C. Jones, of the Johns Hopkins University, has received a grant of $1,000 from the Carnegie Institution for research in physical chemistry during the year 1904–1905. The grant will be used for a research assistant, Dr. H. P. Bassett, who is now working at the Johns Hopkins University. This is a renewal of the grant which was made to Professor Jones for the year 1903–1904, and with which he received the assistance for the present year of Dr. F. H. Getman.

The Carnegie Institution has renewed its grant of last year of $500 to Professor M. Gomberg, of the chemistry department of the University of Michigan. This sum is expended for the payment of an assistant.

At the recent council meeting of the American Anthropological Association, held at the American Museum of Natural History, New York, Mr. George Grant MacCurdy was elected secretary of the association in the place of Dr. A. L. Kroeber, resigned.

Dr. Carlo von Marchesetti has been appointed director of the botanical gardens at Trieste.

Sir William Ramsay, of University College, London, will give the address at the next commemoration day of the University of Glasgow. His subject will be 'Joseph Black,' lecturer on chemistry 1756–66 in the old college, and enunciator of the doctrine of latent heat.

The death is announced, on February 4, of Dr. Kazuyoshi Taguchi, professor of anatomy in the medical faculty of the University of Tokio.

The second annual meeting of the South African Association for the Advancement of Science was opened at Johannesburg, on April 4, when Sir Charles Metcalfe delivered the inaugural address. Lord Milner occupied the chair.

Reuter's Agency is informed that the British Antarctic vessel *Discovery*, with Captain Scott and his staff, is not likely to return to England before the autumn. Some little time will be spent at Christchurch in repairing the vessel, after which Captain Scott will enter upon the work of taking a line of soundings between New Zealand and Cape Horn. It is expected that the relief ships *Morning* and *Terra Nova* will sail direct for home.

The Goldsmith's Company has given £1,000 to the Royal Society for research on radium and radio-active bodies.

The Institute of France has received a bequest from M. Jean Debrousse, yielding an annual income of about $6,000. A thousand dollars has been appropriated for the publication of a lunar table.

Professor J. H. van't Hoff has placed at the disposal of the *Zeitschrift für Physikalische Chemie* the sum of $300 for prizes for papers on the literature of the phenomena of catalysis. The papers may be published in the journal and must be received before June 30, 1905.

The Royal Astronomical Society is making a collection of portraits of its past presidents, and has recently received from Sir Robert Ball a portrait of Professor Brinkley; of Manuel Johnson, who was Radcliffe observer in the middle of the last century, and of Dr. Rambaut.

The U. S. Civil Service Commission announces an examination on April 19–20, to secure eligibles to fill a vacancy in the position of assistant (male) in the Nautical Almanac Office, at $1,000 per annum, and other similar vacancies as they may occur. The commission also announces an examination on May 11–12, 1904, for the position of assistant biologist (male) in the Division of Biological Survey, Department of Agriculture, at $1,200 per annum.

The Lake Laboratory announces courses of instruction in various branches of zoology and

botany for the summer of 1904. As in previous years, provision is made for the accommodation of investigators, no fee being charged to those who do independent work, but each investigator being expected to furnish his own microscope or any special apparatus required unless otherwise arranged. The laboratory building completed last summer is beautifully located on Cedar Point across the bay from Sandusky and furnishes very advantageous opportunities for study and research. Persons enrolled at the laboratory are given free transportation on the steamers of the Cedar Point Resort Company. This makes it very convenient to visit neighboring localities and permits a wide choice in living. The enrolment for last summer included teachers and students from a number of colleges and universities, chiefly in the central states. Announcements and full information may be secured from the director, Professor Herbert Osborn, Ohio State University, Columbus, Ohio.

THE magnetograph records of the Magnetic Observatory of the Coast and Geodetic Survey, situated at Cheltenham, Maryland, showed effects apparently to be attributed to two recent earthquakes, one of which occurred in the state of Washington and in British Columbia on the night of March 16, and the other in New England, in the early morning of March 21. The curve showing the variations of the magnetic declination revealed three faint but distinct seismic disturbances on March 16 at 10^h53^m, 10^h59^m, 23^h03^m P.M., eastern time, the first being the most pronounced. On March 21, the same curve showed a very plain seismic disturbance at 1^h08^m, eastern time. The times in both instances are in fair agreement with the reported times in the newspapers. In neither instance were the horizontal and vertical intensity curves affected.

THE Canadian Government has purchased for $75,000 the steamer *Gauss*, which was built three years ago for the German Antarctic expedition at a cost of $125,000. She is to be commanded by Captain Bernier, and will be employed at once in conveying relief stores and coal to the government steamer *Neptune*, at present wintering in Hudson Bay. Subsequently she will be engaged in survey work on the coast of Labrador. It is said that Captain Bernier hopes to be able to utilize the *Gauss* in 1905 in an attempt to reach the North Pole from Canada.

THE directors of the Manchester Chamber of Commerce have resolved to urge upon the city corporation that in the interest of the general wellbeing of the district a municipal industrial and commercial museum should be established and constantly replenished for the purpose of exhibiting permanently the raw materials and manufactures of British Colonies, India, and foreign countries. Such an institution they regard as an invaluable means of instruction as to the requirements and economic situation of other countries, and as an authoritative source of information as to the customs and habits of their peoples.

A CORRESPONDENT writes to the London *Times* that it is officially announced that the secretary of state for India has sanctioned the decision of the government of India to establish an agricultural research station, with an experimental farm and an agricultural college, at Pusa, in the Darbhangah district of Bengal, and to devote to the purpose the donation recently entrusted to the Viceroy by Mr. Henry Phipps for some object of public utility, preferably for scientific research. The farm is to serve as a model for similar institutions under provincial governments, some of the existing institutions being in need of improvement. Lines of experiment are to be initiated and tested before being recommended for trial under local conditions on the provincial farms; seed of improved varieties will be grown for distribution in the different provinces; results reported from other farms will be tested; scientific research work will be carried on; and practical training will be given to students at the college, which is to be known as the Imperial Agricultural College. The students' course will be one of five years, and it will be open to young men from all parts of India. The government will look to the institution to provide them with teachers of agricultural subjects, with managers of experimental or demonstration farms, and with officers of the Court of Wards. At the same time the trained

staff and laboratories at Pusa will provide facilities for the application of higher science to those agricultural problems the importance of which to the welfare of India and its people can hardly be exaggerated. Mr. Bernard Coventry, manager of the Dalsingh Serai estate, has been appointed principal, and enters upon his new duties forthwith, but the college will not be ready to receive students until August or September of next year.

The five-foot equatorial telescope, with Newtonian and Cassegrain mirrors, and many other astronomical and optical instruments belonging to the late Dr. Common, are offered for sale by T. A. Common, 88 Wigmore Street, London, W.

UNIVERSITY AND EDUCATIONAL NEWS.

The Drapers' Company, in addition to their previous gift of £10,000, have promised £5,000 to the building fund of University College, Cardiff.

The secretary of state for India has vetoed the proposal to abolish the engineering college at Coopers Hill, the proposal having been warmly opposed by the government of India, and by the Departments of Public Works, Forests and Telegraphs, which are recruited from the college.

According to *The British Medical Journal*, the total number of students attending the French universities is 30,405, made up as follows: Paris 12,985, Aix-Marseille 1,080, Besançon 333, Bordeaux 2,320, Caen 752, Clermont 299, Dijon 880, Grenoble 705, Lille 1,164, Montpellier 1,707; Nancy 1,327, Poitiers 863, Rennes 1,190, Lyon 2,069, Toulouse 2,291. The Arts Faculty has 4,384 students, of whom 3,873 are French. It has 613 women students. Law has 10,972 students, and of these 4,382 belong to the University of Paris and 1,021 to Toulouse. In the Faculty of Science there are 4,765 students, of whom 1,546 attend the Paris Faculty, 552 that of Lyon, and 476 at Nancy. There is a total of 6,686 students of medicine, of whom 6,115 are French. They are distributed as follows: Paris 3,496, Lyon 958, Bordeaux 654, Montpellier 552. There are 571 foreigners attending this Faculty, of whom 197 belong to Persia, 89 to Turkey, 63 to Bulgaria, and 57 to Roumania. To these must be added 202 French women students and 164 women students from abroad, together with 1,558 students who are taking the course of medicine and pharmacy. Besides these there are 3,014 students of pharmacy.

Mr. J. G. Jack will conduct a field class at the Arnold Arboretum on Saturdays during the spring and early summer, to assist those who wish to gain a more intimate knowledge of the native and foreign trees and shrubs which grow in New England.

At a meeting of the trustees of Columbia University, on April 11, the heads of the departments of civil, mechanical, electrical and mining enginering and of metallurgy were assigned to seats in the faculty of pure science. Dr. William T. Bull, professor of surgery, tendered his resignation, to take effect on June 30.

The senate of London University has resolved to establish a degree in veterinary science in the faculty of science.

At Harvard University Dr. C. L. Bouton has been appointed assistant professor of mathematics and Mr. G. S. Reyner, assistant professor of mining; Dr. H. W. Morse has been appointed instructor in physics.

Miss Mary Perle Anderson, who had charge of the instruction in nature study in the summer session at Columbia University in 1903, has been appointed instructor in botany at Mt. Holyoke College for the coming year. Miss Anderson has recently received the first prize for an essay on the preservation of native plants awarded by the New York Botanical Garden.

Mr. Sidney Skinner, M.A., of the Cavendish Laboratory, and director of natural science studies at Clare College, Cambridge, has been appointed principal of the Southwestern Polytechnic, Chelsea.

Mr. W. L. Symes, M.R.C.S., has been appointed scientific assistant in physiology at London University. Mr. John Herbert Parsons has been awarded the degree of doctor of science in physiology as an external student.